IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re CONTINUATION APPLICATION

Applicant(s): Brian Agee, et al — Examiner: Unassigned

Application No.: Cont. of 08/993,721 — Group: Unassigned

Filed: Herewith

For: HIGHLY BANDWIDTH EFFICIENT COMMUNICATIONS

PRELIMINARY AMENDMENT

Commissioner of Patents
Washington, D.C. 20231

Sir:

Prior to official Office Action, please amend the above-identified continuation application as follows:

IN THE DRAWINGS

Please REPLACE the drawings filed with this application with the attached SUBSTITUTE Drawings. No new matter is added by replacing the drawings. The corrected drawings are submitted to render the drawing labeling consistent with the amendments to the specification set forth below.

IN THE SPECIFICATION

Please REPLACE the following paragraphs in the specification as follows:

Page 11, line 32 through page 16, line 16, the Brief Description of the Drawings Section:

In the drawings:

FIGURE 1A is a tutorial diagram illustrating an example of pure spectral diversity, showing how a receiver distinguishes two sets of discrete multitone signals from two transmitters that are placed close to one another, in accordance with the invention.

FIGURE 1B is a tutorial diagram illustrating an example of pure spatial diversity, showing how a receiver distinguishes two discrete monotone signals from two transmitters that are placed far from one another, in accordance with the invention.

FIGURE 1C is a tutorial diagram illustrating an example of both spectral and spatial diversity, showing how a receiver distinguishes two discrete multitone signals from two transmitters that are placed far from one another, in accordance with the invention.

FIGURE 1D is a high-level schematic representation of an implementation of the invention in a fixed wireless communication system.

FIGURE 2 is a simplified representation of multitone transmission.

FIGURE 3 is a simplified representation of the use of a discrete multitone stacked carrier signal format.

FIGURE 4 is a simplified representation of the matrix formalism used in an implementation of the invention.

FIGURE 5 is a simplified representation of the matrix formalism, used in an implementation of the invention, that includes the effects of channel response.

FIGURE 6 is a simplified representation of DMT-SC using an exemplary higher order QAM modulation format.

FIGURE 7 is a timing diagram that illustrates the general time division duplex signal and protocol used in an embodiment of the invention.

FIGURE 8 is a signal processing flow diagram that depicts the main signal processing steps used in an embodiment of the invention to provide for high bandwidth efficiency.

FIGURE 9 is a signal processing flow diagram that illustrates a method used to spread the encoded carrier signal.

FIGURE 10 is a three-dimensional plot of the signal to interference plus noise ratio versus code weights and spatial weights applied to the transmitted and received signals.

FIGURE 11 is a perspective cut away view showing an embodiment of a base station antenna.

FIGURE 12 is a perspective cut away view showing a second embodiment of a base station antenna.

FIGURE 13 graphically depicts the null steering aspect of the present invention.

FIGURE 14 is a schematic representation of an inverse frequency channelized spreader implementation.

FIGURE 15 is a schematic representation of a frequency channelized despreader implementation.

FIGURE 16 is a plot of antenna gain versus angular direction.

FIGURE 17 is a highly simplified block diagram that illustrates one particular application of the highly bandwidth-efficient communications network of the present invention.

FIGURE 18 is a list of the possible operational frequency bands of a specific embodiment of the invention.

FIGURE 19 shows the RF Band/Sub-band organization of the airlink of a specific embodiment of the invention.

FIGURE 20 shows the tones within each sub-band of a specific embodiment of the invention

FIGURE 21 shows the traffic partitions in a specific embodiment of the invention

FIGURE 22 shows the tone mapping to the ith traffic partition

FIGURE 23 shows the overhead tone Mapping to Channels for the ith Sub-band Pair

FIGURE 24 shows the Division of Tone Space to Traffic and Overhead Tones

FIGURE 25 shows the time Division Duplex format for Base and Remote Unit Transmissions

FIGURE 26 shows Details of the Forward and Reverse Channel Time Parameters

FIGURE 27 shows the TDD Parameter Values

FIGURE 28 shows the Physical Layer Framing Structure

FIGURE 29 shows the Phase A Sub-band Pair Assignment Within a Spatial cell

FIGURE 30 shows the Phase-A Sub-band Pair Assignment Across Spatial cells

FIGURE 31 is a Functional Block Diagram for the Upper Physical Layer of Base Transmitter for High Capacity Mode

FIGURE 32 is a Data Transformation Diagram for the High Capacity Forward Channel Transmissions

FIGURE 33 is a Functional Block Diagram for the Upper Physical Layer of Base Transmitter for Medium Capacity Mode

FIGURE 34 is a Data Transformation Diagram for the Medium Capacity Forward Channel Transmissions

FIGURE 35 is a Functional Block Diagram for the Upper Physical Layer of Base Transmitter for Low Capacity Mode

FIGURE 36 is a Data Transformation Diagram for the Low Capacity Forward Channel Transmissions

FIGURE 37 is a representation of the Triple DES Encryption Algorithm

FIGURE 38 depicts a Feed Forward Shift Register Implementation of Rate 3/4, 16PSK Trellis Encoder for High Capacity Mode

FIGURE 39 depicts a Feed Forward Shift Register Implementation of Rate 3/4, 16QAM Trellis Encoder for High Capacity Mode

FIGURE 40 shows the Signal Mappings for Rate 3/4, 16QAM and 16PSK Trellis Encoding Schemes Employed in High Capacity Mode

FIGURE 41 shows the Signal Mappings for Rate 3/4, Pragmatic 16 QAM and 16 PSK Trellis Encoding Schemes Employed in High Capacity Mode

FIGURE 42 depicts a Feed Forward Shift Register Implementation of Rate 2/3, 8PSK Trellis Encoder for Medium Capacity Mode

FIGURE 43 depicts a Feed Forward Shift Register Implementation of Rate 2/3 8QAM Trellis Encoder for Medium Capacity Mode

FIGURE 44 shows the Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode

FIGURE 45 shows the Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode

FIGURE 46 depicts a Feed Forward Shift Register Implementation of Rate 1/2 Convolutional Encoder for Low Capacity Mode

FIGURE 47 shows the Signal Mapping for Rate 1/2, QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode

FIGURE 48 shows the Gray-Coded Mapping for Rate 1/2, QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode

FIGURE 49 shows the Base Mapping of Elements of Received Weight Vectors to Antenna Elements and Tones

FIGURE 50 is a Block Diagram Representation of CLC Physical Layer Format

FIGURE 51 shows the QPSK Signal Mapping for the CLC Channel

FIGURE 52 is a representation of the CLC Interleaving Rule

FIGURE 53 shows the Tone Mapping of (4 x 4) Interleaved Matrix Elements

FIGURE 54 is a Block Diagram Representation of BRC Physical Layer Format

FIGURE 55 shows the Tone Mapping of the (4 x 4) Interleaved Matrix Elements

FIGURE 56 is a representation of a Broadcast Channel Beam Sweep

FIGURE 57 is a Functional Block Diagram of the Upper Physical Layer of Remote Unit Transmitter for High Capacity Mode

FIGURE 58 is a Data Transformation Diagram for the High Capacity Reverse Channel Transmissions

FIGURE 59 is a Functional Block Diagram for the Upper Physical Layer of Remote Unit Transmitter for Medium Capacity Mode

FIGURE 60 is a Data Transformation Diagram for the Medium Capacity Reverse Channel Transmissions

FIGURE 61 is a Functional Block Diagram for the Upper Physical Layer of Remote Unit Transmitter for Low Capacity Mode

FIGURE 62 is a Data Transformation Diagram for the Low Capacity Reverse Channel Transmissions

FIGURE 63 shows the Remote Unit Tone Mapping of Received Weight Vector Elements

FIGURE 64 is a Block Diagram Representation of the CAC Physical Layer Format

FIGURE 65 shows the BPSK Signal Mapping for the CAC Channel

FIGURE 66 depicts the CAC Interleaving Rule

FIGURE 67 shows the Tone Mapping of the (8 x 2) Interleaved Matrix Elements

FIGURE 68 is a Functional Block Diagram for the Lower Physical Layer of Base Transmitter

FIGURE 69 shows Tone Mapping into DFT Bins

FIGURE 70 shows Tone Mapping into DFT Bins

FIGURE 71 is a block diagram that illustrates the main structural and functional elements of the bandwidth on demand communications network of the present invention.

FIGURE 72 is a functional block diagram that illustrates the main functional elements of the high bandwidth remote access station.

FIGURE 73 is a functional block diagram that shows the main functional components of the high bandwidth base station.

FIGURE 74 is an overall system schematic block diagram that shows the main structural and functional elements of one implementation of the highly bandwidth-efficient communication system in greater detail.

FIGURE 75A depict the digital architecture within an exemplary remote access terminal.

FIGURE 75B depict the digital architecture within an exemplary remote access terminal.

FIGURE 76 is a software block diagram that indicates the general processing steps performed by each of the digital signal processing chips within the digital signal processing architecture of FIGURES 75A and 75B.

FIGURES 77A-77D are block diagrams that show in detail the digital architecture of the LPA cards of FIGURES 75A and 75B.

FIGURES 78A-78C are block diagrams that detail the digital architecture used to support the main digital signal processing chips on the interface card of FIGURES 75A and 75B.

FIGURES 79A-79D are a schematic block diagram that depicts the overall digital signal processing architectural layout within an exemplary base station of the present invention.

FIGURE 80 is a schematic block diagram showing a dual band radio frequency transceiver that may advantageously be used in the high bandwidth remote access station shown in FIGURE 74.

FIGURE 80A is a schematic block diagram showing the main internal functional elements of the synchronization circuitry shown in FIGURE 80.

FIGURE 81 is a schematic block diagram depicting a dual band radio frequency transceiver that may advantageously be implemented within the high bandwidth base station shown in FIGURE 74.

FIGURE 81A is a simplified schematic block diagram showing the main internal components of the frequency reference circuit shown in FIGURE 81.

FIGURE 82 is a schematic block diagram of a dual band radio frequency transmitter of a type that may advantageously be implemented within a base station constructed in accordance with the present invention.

FIGURE 83 depicts the bandwidth allocation method performed by the bandwidth demand controller of FIGURE 74.

FIGURE 84A and FIGURE 84B show an alternate embodiment of the invention, where the spectral processing and the spatial processing are separated.

FIGURE 85 is an illustrative flowchart of an embodiment of the adaptive solution of spectral and spatial weights.

FIGURE 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

FIGURE 87 is a block diagram of a base station included in FIGURE 86.

FIGURE 88 is a flow diagram which implements the operation of the invention of FIGURES 86 and 87.

FIGURE 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

FIGURE 90 is an architectural diagram of the remote station X as a sender.

FIGURE 91 is an architectural diagram of the base station Z as a receiver.

FIGURE 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

FIGURE 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

FIGURE 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

FIGURE 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

FIGURE 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

FIGURE 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

FIGURE 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

FIGURE 99 is a flow diagram of the sequence of operational steps for the invention.

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of FIGURE 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

FIGURE 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

FIGURE 103 is a network diagram of the two cells of FIGURE 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

FIGURE 104 is a network diagram of the four cells similar to FIGURES 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

FIGURE 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

FIGURE 106 is a detailed block diagram similar to FIGURE 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

Page 96, lines 18 to 29:

Figure 85A, consisting of Figures 85 A-L and 85 A-R, is a flow diagram of a preferred embodiment, describing the computational steps performed in the base station. In the transmission portion of the base station, traffic symbols are input on line 5 to the smear matrix step 10. Link maintenance pilot signals are input on line 7 to the digital signal processor (DSP) data processing RAM 12. Stored pilot signals are output from the RAM 12 to the link

maintenance pilot (*LMP) register 14 and are then applied as one input to the smear step 10. The smear matrix 16 is also applied to the smear step 10. The output of the smear matrix 16 is also applied to the smear step 10. The output of the smear step 10 is applied to the gain emphasis step 20. The values from the gain RAM25 are applied to the gain emphasis step 20 to provide output values which are then applied to the beam form spreading step 30. Spreading weights in a spread weight RAM 32 are applied to the beam form spread step. The X vector is output on line 40 from the beam form spread step and is sent to the transmitter for transmission to the remote station.

Page 97, lines 25 through 36:

Figure 85B, consisting of Figures 85B-L and 85B-R, shows the processing of the common access channel signals. Two common access signals (CAC) signals from the transmitter are processed. A first signal is processed being received on the input line 102 and is applied to the RMGS auto-correlation step 104, whose output goes to the digital signal matrix step 106 whose output goes to the digital signal processor. The common access channel signal online 102 is also applied to the select ungated packets step 108 and to the select gated packets step 110. The output of the select ungated packets 108 is applied to the subtract even/odd packets step 112. The output of the selected gate packets 110 is applied to the apply code key step 114. The CAC code key step 116 applies it's value to the apply code key step 114. the output of the apply code key step 114. The output of the apply code key step 114 is also applied to the subtract even/odd packets step 112. The output of the subtract even/odd packets step 112 ids applied to the RMGS autocorrelation step 118, whose output is also applied to the compute T matrix step 106. The output of the compute T matrix step 106 is then applied to the digital signal processor.

Page 106, the Brief Description of the Drawings Section:

Figure 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

Figure 87 is a block diagram of a base station included in Figure 86.

Figure 88 is a flow diagram which implements the operation of the invention of Figures 86 and 87.

Page 106, line 15 through page 107, line 2:

In Figure 86, a remote station "X" and a remote station "Y" are coupled to a base station "Z" over a wireless link using traffic channels for data traffic, and a common access channel (CAC) and a common link channel (CLC) for control information. Each remote station includes a plurality of subscribers coupled to a transmitter/receiver which uses the discrete multitone spread spectrum protocol for transmissions. Communication between the remote stations and the base station is performed in the manner described in the above cited S. Alamouti et al. and E. Hoole et al. applications.

Page 109, line 6 through line 14:

In Figure 87, a base station further includes a spectral and spatial despreading processor 312 which interacts with the spreading and despreading databases in accordance with the S. Alamouti et al. application previously cited. The processor is coupled to a decoder which provides an output to a vector disassembly buffer 316 for generating subscriber data originated in a call. The decoder is also coupled to a subscriber database buffer which contains information related to the subscriber name, number and other standard subscriber information including, for

example, subscriber profiles. The output of the database buffer is provided to a call set up processor 330 or an error processor 322 as will be described in more detail hereinafter. The processors 330 and 322 are connected to the network switch 202.

Page 109, line 15 through page 110, line 15:

The operation of Figures 86 and 87 will now be described in conjunction with Figure 88. In step 710, a subscriber coupled to a remote station originates a call which initiates an "off hook" condition at the station. A set up connection request is initiated by the remote station in a step 720. The remote station transmits setup request message; the remote station ID and subscriber line number to the base station using a CAC tone. The base station responds to the set up connection request in step 730 and accesses the database 320 to identify the subscriber and obtain the subscriber profile. Simultaneously, in steps 740 and 743, the base station initiates the establishment of a traffic channel to the remote station and sends the set up request; remote user ID, subscriber line number and subscriber profile to the network switch 202. The network switch initiates the set up in a step 745 and provides dial tone to the subscriber at the remote station. During the process of establishing the traffic channel, the base station performs a test in a step 742 to determine whether a traffic channel has been established between the remote station and the base station. In some instances, the radio propagation characteristics of the channel are such that a link cannot be established. In the event that a link cannot be established, a "no" condition from the test 742 activates the error processor 322 which provides the network switch in a step 744 with a signal to a logic device which signals the network switch to disassemble or "tear down" the call set up in the PSTN, if the base station has sent the set up request message. In response to the logic device signal, the network switch in a step 749 "tears down" the PSTN connections and the process ends. In the instance where the traffic channel is completed, a "yes" condition sends a signal to a logic device whereupon the network switch completes the call in a

step 747, provided the call setup has been initiated and dial tone provided to the subscriber by the network switch.

Page 117, the Brief Description of the Drawings Section:

Figure 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

Figure 90 is an architectural diagram of the remote station X as a sender.

Figure 91 is an architectural diagram of the base station Z as a receiver.

Figure 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

Figure 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

Figure 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

Page 118, line 1 through line 22:

Figure 89 is an architectural diagram of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent application. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to

provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure B1 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

Page 120, line 15 through page 121, line 11:

The following describes the operation of the remote station X in sending system management messages to the base station Z. The remote station and the base station are part of a wireless discrete multitone spread spectrum communications system. The remote station, which is the sending station in this example, includes a priority message processor 204 shown in Figure 90 and in Figure 92, that selects the order in which system management messages are transmitted over the link control channel (LCC). The order of selection is by the time criticality of the

message. Those messages having a greater time criticality are selected to be transmitted first. The priority message processor 204 in the sending station is programmed by program 400 of Figure 92, to rank call control messages, connect messages, acknowledgement messages for call control, and signaling messages, for example, to have a greater time criticality than system status messages or software downloads have. The burst size transmitted from a sending station is a fixed number of bits long, for example forty-eight bits in length. If the message to be sent is longer than the burst size, then the priority message processor 204 at the sending station uses the priority message buffer 420 in Figure 92, to break the message into segments. In accordance with the invention, a priority interrupt flag "P" of one bit in length is included with each message segment, to identify whether the segment is the first occurring segment in a message. A first segment of a message, with a priority interrupt flag bit P = 1, will be sent in a first occurring transmit burst time. The remaining segments that are not the first segment of a message, those segments with a priority interrupt flag bit P = 0, will be sent in a later occurring transmit burst times. This enables the sending station and the receiving station to cooperate in managing the communication of system management messages having differing time criticality.

Page 122, lines 11 through 22:

In accordance with the invention, the base station Z of Figure 91 receives the burst with the first spread signal and the second spread signal. The base station adaptively despreads the first spread signal received by using despreading weights in the spectral and spatial despreading processor 312, recovering the data portion. The base station also adaptively despreads the second spread signal received by using despreading weights, recovering the message segment portion and the priority interrupt flag portion. The base station includes a priority message processor 320 shown in Figure 91 and in Figure 94, that receives from the link control channel, the first message segment of the call control message. The priority message processor 320 at the

base station then resets a message segment buffer 322 in the base station and stores the first segment of the call control message in the buffer 322, if the priority interrupt flag "P" has a first value of one. The first value of one for the priority interrupt flag "P" corresponds to a time critical message segment. This operation effectively substitutes the more time critical call control message for the first, status message at the base station Z.

Page 123, lines 7 through 20:

In an alternate embodiment of the invention, the base station's priority message processor 320 of Figure 94, selectively reassigns its message processing capacity from low priority messages it is currently transmitting, to more time critical messages that it receives on the link control channel. In accordance with the invention, the base station Z is currently transmitting a transmitted spread signal comprising an outgoing data traffic signal spread over a plurality of discrete traffic frequencies and an outgoing message segment signal spread over a plurality of link control frequencies. This takes place during the transmit interval of a time division duplex session with the remote station X. The outgoing message segment signal from the base station is part of a low priority message, such as a software download to the remote station. During the next receive interval of the time division duplex session, the base station Z receives a spread signal comprising an incoming data traffic signal spread over a plurality of discrete traffic frequencies and an incoming message segment signal spread over a plurality of link control frequencies. The base station adaptively despreads the signals received at the base station by using despreading weights in its spectral and spatial despreading processor 312 of Figure 91. Then the base station's priority message processor 320 of Figure 94, detects a priority interrupt flag value "P" in the message segment signal.

Page 123, line 21 through page 124 line 19:

In accordance with the alternate embodiment of the invention, the base station's priority message processor 320 acts to reassign the station's message processing capacity by interrupting the next scheduled transmission of the second outgoing message segment signal. An example where this operation is required is when the remote station X sends a call control message to the base station that requires the base station to quickly respond with a reply message. The priority message processor 320 detects the priority interrupt flag P = 1 in the first segment of the call control message, and in response, resets the message segment buffer 322 in the base station. The priority message processor 320 stores the incoming message segment signal in the message segment buffer 322. The priority message processor 320 of Figure 94, determines that the call control message received from the remote station requires a quick reply. In response to this, the priority message processor 320 at the base station stores the last segment number sent for the low priority outgoing message it has been sending to the remote station. The base station can then transmit its reply message to the remote station. In this manner, quick reply message can be sent in response to request messages. After the reply message has been sent by the base station, the last segment number sent for the low priority outgoing message is retrieved by the priority message processor 320 and transmission is resumed by the base station, starting with the next segment number for the low priority outgoing message. Alternately, the base station concatenates the incoming message segment signal with a previously received message segment, if the priority interrupt flag has a second value of zero. The second value of zero for the priority interrupt flag corresponds to a message segment that is not a first message segment in a message having plural segments. In this manner, the invention manages the exchange of system management messages over the link control channel between a remote station and the base

station so that time critical system management messages are given priority over those that are not time critical.

Page 124, line 20 through page 125, line 6:

In Figure 90, Alice and Bob each input data to remote station X. The sender's traffic data is sent to the vector formation buffer 202 and the sender's system management information is sent to the priority message processor 204, shown in greater detail in Figure 92. Data vectors are output from buffer 202 to the trellis encoder 206. The data vectors are in the form of a 48-bit data message segment per transmit burst. The LCC vectors output from the priority message processor 204 to the trellis encoder 206 are in the form of a 48-bit priority message segment per transmit burst, formed by concatenating a 47-bit message segment with the one-bit priority interrupt flag. The trellis encoded data vectors and LCC vectors are then output to the spectral spreading processor 208. The resultant data tones and LCC tones are then output from processor 208 to the transmitter 210 for transmission to the base station.

Page 125, lines 7 through 13:

The first four steps in the flow diagram 700 of Figure 93 show the steps at remote station X when it is the sender. The steps in the method of transmission from a remote station to a base station are first for the Remote Station in step 710 to generate a priority message segment in the priority message processor 204 of figure 92 and input it as a vector to the link control channel. Then in step 720, the Remote Station performs trellis encoding of the link control channel vector and the data vectors. Then in Step 730, the Remote Station performs spectral spreading of the trellis encoded link control channel vector and data vectors. Then in Step 740, the Remote Station transmits the link control channel tone and data tones to the base station.

Page 127, lines 6 through 13:

Figure 91 is an architectural diagram of the base station Z as a receiver. The data tones and LCC tones are received at the base station antennas A, B, C, and D. The receiver 310 passes the data tones and the LCC tones to the spectral and spatial despreading processor 312. The despread signals are then output from the processor 312 to the trellis decoder 314. The data vectors are then output to the vector disassembly buffer 316. The LCC vectors are output to the priority message processor 320, shown in greater detail in Figure 94. Alice's data and Bob's data are output from the buffer 316 to the public switched telephone network (PSTN). Priority message segments are passed from the priority message processor 320 to the priority message buffer 322. There the segments are concatenated into a full message 325 to be output on line 330.

Page 127, line 14 through page 128, line 2:

The last five steps in the flow diagram 700 of Figure 93, show the base station Z as the receiver. In Step 750, the Base Station performs spectral and spatial despreading of the link control channel tone and data tones. Then, in Step 760, the Base Station performs trellis decoding of despread link control channel tone and data tones. Then in Step 770, the Base Station's priority message processor 320 determines if the priority interrupt flag P = 1. If it does, then priority message processor 320 resets the priority message buffer 322 and loads the newly received message segment in buffer 322. In step 780, alternately, if the Base Station's priority message processor 320 determines that the priority interrupt flag P = 0, then it concatenates the newly received message segment with the previously received message segment for the same message in buffer 322. Then in Step 790, the priority message buffer 322 combines the plural message segments into a complete message and outputs it on line 330. The completed message

can be processed within the base station or it can be forwarded along with the received data to the public switched telephone network.

Page 133 to 134, the Brief Description of the Drawings:

Figure 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

Figure 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

Figure 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

Figure 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

Figure 99 is a flow diagram of the sequence of operational steps for the invention.

Page 134, line 5 to page 135, line 19:

Figure 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel. Figure 96 shows the remote station transmitting a functional quality and maintenance message to the base station over the common access channel. These are diagrams of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent applications. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to

the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure 95 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

Page 137, lines 10 through 20:

In accordance with the invention, a new method makes the most efficient use of the scarce spectral bandwidth in a wireless discrete multitone spread spectrum communications system. Each remote station in the network collects functional quality and maintenance data for itself. During each data traffic session that a remote station has with the base station, the remote station X of Figure 97 computes the signal-to-interference-and-noise ratio (SINR) as a byproduct of receiving the discrete multitone spread spectrum signals from the base station Z. The remote station stores the SINR data that it accumulates in a SINR history buffer 224. The remote station also computes the path loss of the signals received from the base station and stores the values it accumulates in a path loss history buffer 226. The remote station runs self-test programs on a periodic basis and stores the results in a self-test results buffer 220. And the remote station monitors the status of its backup battery and stores the status in a battery status buffer 222. Other functional quality and maintenance data can also be monitored by the remote station and stored in buffers.

Page 137, line 21 through page 138, line 11:

In accordance with the invention, the base station Z periodically transmits a discrete multitone spread spectrum (DMT-SS) signal on the common link channel to each remote station, polling the respective remote station, as shown in Figure 95. The common link channel (CLC) is used by the base to transmit control information to the remote stations. Simultaneously, data traffic from the public switched telephone network (PSTN) arrives at the base station Z and is converted into data traffic DMT-SS tones which are transmitted to the remote stations. In response to the base station's polling signal being received by the remote station X at its input 230, the respective remote station of Figure 97, activates its polling response processor 228 to respond the poll. The polling response processor 228 accesses the self test buffer 220, the

battery status buffer 222, the SINR history buffer 224, and the path loss buffer 226 to assemble a functional quality and maintenance data message. The message is formed into a common access channel vector that is input to the trellis encoder 206 and then to the spectral spreading processor 208 to produce the common access channel tone. The common access channel tone with the functional quality and maintenance data message is then transmitted by transmitter 210 as a DMT-SS signal back to the base station Z on the common access channel.

Page 138, line 20 through page 139, line 3:

When the base station Z of Figure 98 receives the functional quality and maintenance message on the common access channel tone from the remote station X that it has polled, it performs spectral and spatial despreading of the signal in the spectral and spatial despreading processor 312 and trellis decoding of the signal in the trellis decoder 314 to obtain a common access channel vector bearing the functional quality and maintenance data. The functional quality and maintenance data are then stored in the functional quality and maintenance archive buffer 320, organized by each responding remote station.

Page 141, line 9 through page 142, line 3:

Figure 99 is a flow diagram 700 of the sequence of operational steps for the invention. In step 710, the remote station monitors and buffers the functional quality data, including the SINR and path loss for sessions with the base station. In step 720, the remote station monitors and buffers the maintenance data, including self-test results and battery status, for the remote station. In step 730, the base station transmits a polling signal on the common link channel tone to the remote station. In step 740, the remote station accesses the functional quality data and the maintenance data from its buffers, assembles the data into a message vector, and transmits it on the common access channel tone to the base station. The remote station simultaneously

transmits data traffic channel tones to the base station. In step 750, the base station performs spectral and spatial despreading of the common access channel tone and the data traffic tones. In step 760, the base station performs trellis decoding to recover the common access channel vector bearing the functional quality and maintenance message. In step 770, the base station archives the functional quality and maintenance data. In step 780, the base station analyzes the functional quality data and updates the despreading and spreading weights to maximize the quality of the channels it establishes with the remote station. In step 790, the base station analyzes the maintenance data and outputs maintenance notices to repair or replace failing components at the remote station. In this manner, functional quality and maintenance data can be communicated from the remote stations to the base station without adversely affecting the transmission of messages having greater time criticality.

Page 153, in the Brief Description of the Drawings:

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of Figure 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

Page 153, line 12 through 17:

Figure 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y. The signal received by the remote station X has a signal power level that is less than the prearranged initial forward

signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The remote station stores the value of the channel loss it measures.

Page 154, line 1 through line 11:

Figure 101 is an architectural diagram of the personal wireless access network (PWAN) of Figure 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z. The signal received by the base station Z has a signal power level that is less than the prearranged initial reverse signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The base station stores the value of the channel loss it measures. The base station includes a retrodirective power management unit. The base prepares despreading weights to despread the DMT-SS signals it receives from the remote station X. Then the base uses the principle of retrodirectivity to compute spreading weights for transmission of DMT-SS signals to the remote station X. The spreading weights calculated at the base station include a factor based on the measured channel loss stored at the base station, to overcome the channel loss so that forward signals transmitted to the remote station X will arrive there with a desired received signal power level.

Page 155, line 1 through page 156, line 5:

Figure 100 illustrates the personal wireless access network (PWAN) system described in the referenced Alamouti, et al. patent application. Two users, Alice and Bob, are located at the remote station X and will exchange their respective data messages with the base station Z. Station X is positioned to be equidistant from the antenna elements A and B, of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also will exchange their respective data messages with the base station Z. Station Y is geographically remote from

Station X and is not equidistant from the antenna elements A and B of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure 100 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location. The PWAN system has a total of 2560 discrete tones (carriers) equally spaced in 8 MHz of available bandwidth in the range of 1850 to 1990 MHz. The spacing between the tones is 3.125 kHz. The total set of tones are numbered consecutively form 0 to 2559 starting from the lowest frequency tone. The tones are used to carry traffic messages and overhead messages between the base station and the plurality of

remote units. The traffic tones are divided into 32 traffic partitions, with each traffic channel requiring at least one traffic partition of 72 tones.

Page 177, in the Brief Description of the Drawings:

Figure 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Figure 103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

Figure 104 is a network diagram of the four cells similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Figure 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

Figure 106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

Page 178, line 2 through line 9:

Figure 102 is a network diagram of two cells 1 and 2, in a PWAN communications system. Base station B1 communicates with remote stations R1 and R1' using the DMT-SS protocol. The notation (B1->R1') indicates the path from base station B1 to the remote station R1', for example. The notation (R1'->B1) indicates the path from remote station R1' back to the base station B1. The notation (R2->B1) indicates the path from remote station R2 in the neighboring cell 2 to the base station B1. Base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. In accordance with the invention, base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Page 178, line 10 through 19:

Figure 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1. Remote station R1' in the same cell as base station B1, sends data tones and pilot tones to base station B1 using the DMT-SS protocol. Remote station R2 in the neighboring cell 2 sends an interfering signal to base station B1, also using the DMT-SS protocol. The base station B1 calculates optimum weights based on all of the signals received at the base station using the adaptive processor. Since the set of tone frequencies on the receive path is the same as the set of tone frequencies on the transmit path, the despreading weights used to receive can be used to compute the spreading weights for transmission, using the principle of retrodirectivity. The adaptive processor computes the value of the despreading weights, adjusted to minimize receive sensitivity to interfering signals from remote station R2.

Page 179, line 1 through 6:

Figure 106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2. The spreading weights derived from the despreading weights are also adaptive, their values being adjusted to diminish the strength of signals transmitted back in the direction of the interfering signal source, R2. Null steering and code nulling are used to adjust the despreading weights and the spreading weights to adaptively minimize the exchange of interfering signals.

Page 179, line 7 through 16:

Figure 102 shows base station B2 communicating with remote stations R2 and R2' using the DMT-SS protocol. Figure 103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength. When adaptive retrodirectivity is used to determine the set of weights for both reception and transmission in each cell of the network, network-wide adaptive retrodirectivity can be accomplished. The base stations and remote stations in each cell use null-steering and code nulling to diminish their interference with stations in other cells. The retrodirective formation of spreading weights from despreading weights in each station propagates channel optimization across cell boundaries.

Page 179, line 17 to 19:

Figure 104 is a network diagram of the four cells 1, 2, 3, and 4, similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Page 180, line 1 through 15:

Figure 102 also shows how the remote station R2 in cell 2 responds to the presence of interference signals it detects from the base station in cell 1, to optimize the multiple cell network for inter-cell interference. As was discussed above, base station B1 is receiving a first spread signal comprising a first data signal spread over a plurality of discrete tones received over a first path (R1'->B1) from remote station R1' located in cell 1. The first signal further includes an interfering signal spread over the plurality of discrete tones received over an interference path (R2->B1) from remote station R2 located in cell 2. Base station B1 is adaptively despreading the signal received by using first despreading codes that are based on the characteristics of the received spread signal over the first path (R1'->B1) and over the interference path (R2->B1). The base station B1 then is spreading a second data signal with first spreading codes derived from the despreading codes based on the retrodirectivity of the first path (R1'->B1) and of the interference path (R2->B1). The first spreading codes are distributing the second data signal over a plurality of discrete tones, forming a second spread signal that is selectively diminished in the interfering path (B1->R2) to the second remote station R2. Then base station B1 continues by transmitting the second spread signal over the first path (B1->R1') to the first remote station R1' and transmitting the second signal selectively diminished over the interference path (B1->R2) to the second remote station R2.

IN THE CLAIMS

Please cancel original claims 1-10, 61-70, 113-122, and 157-233.

REMARKS

This is a preliminary amendment to a continuation application of copending parent application serial number 08/993,721, filed December 18, 1997. Note that the parent application serial number 08/993,721 has not been abandoned.

Original claims 1-10, 61-70, 113-122, and 157-233 are canceled as non-elected claims, and claims 11-60, 71-112, 123-156 and 234-265 remain in the case.

No new matter is presented in the foregoing amendments. The amendments to the specification are set forth to render the specification and drawings consistent with the parent application. Applicants respectfully request entry of the amendments. A marked-up copy of the amendments to the specification is attached hereto as APPENDIX I.

If any other fees are required for the filing of this Preliminary Amendment, please charge same to Deposit Account No. 13-4503, Order No. 4271-4036US3.

Respectfully submitted,

Date: Aug 3, 2001

By: Michael S Marcus

Michael S. Marcus
Registration No. 31,727
202-857-8011 phone
202-857-7929 - fax

SENDER'S ADDRESS:
MORGAN & FINNEGAN, L.L.P.
345 Park Avenue
New York, NY 10154

APPENDIX

MARKED-UP VERSION OF AMENDMENTS

Page 16, line 16, after "spectral and spatial weights.", please ADD the following text:

--FIGURE 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

FIGURE 87 is a block diagram of a base station included in FIGURE 86.

FIGURE 88 is a flow diagram which implements the operation of the invention of FIGURES 86 and 87.

FIGURE 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

FIGURE 90 is an architectural diagram of the remote station X as a sender.

FIGURE 91 is an architectural diagram of the base station Z as a receiver.

FIGURE 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

FIGURE 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

FIGURE 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

FIGURE 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

FIGURE 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

FIGURE 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

FIGURE 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

FIGURE 99 is a flow diagram of the sequence of operational steps for the invention.

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of FIGURE 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

FIGURE 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

FIGURE 103 is a network diagram of the two cells of FIGURE 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

FIGURE 104 is a network diagram of the four cells similar to FIGURES 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

FIGURE 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

FIGURE 106 is a detailed block diagram similar to FIGURE 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.—

Page 96, lines 18 to 29:

Figure 85A, consisting of Figures 85 A-L and 85 A-R, is a flow diagram of a preferred embodiment, describing the computational steps performed in the base station. In the transmission portion of the base station, traffic symbols are input on line 5 to the smear matrix step 10. Link maintenance pilot signals are input on line 7 to the digital signal processor (DSP) data processing RAM 12. Stored pilot signals are output from the RAM 12 to the link maintenance pilot (*LMP) register 14 and are then applied as one input to the smear step 10. The smear matrix 16 is also applied to the smear step 10. The output of the smear matrix 16 is also applied to the smear step 10. The output of the smear step 10 is applied to the gain emphasis step 20. The values from the gain RAM25 are applied to the gain emphasis step 20 to provide output values which are then applied to the beam form spreading step 30. Spreading weights in a spread weight RAM 32 are applied to the beam form spread step. The X vector is

output on line 40 from the beam form spread step and is sent to the transmitter for transmission to the remote station.

Page 97, lines 25 through 36:

Figure 85B, consisting of Figures 85B-L and 85B-R, shows the processing of the common access channel signals. Two common access signals (CAC) signals from the transmitter are processed. A first signal is processed being received on the input line 102 and is applied to the RMGS auto-correlation step 104, whose output goes to the digital signal matrix step 106 whose output goes to the digital signal processor. The common access channel signal online 102 is also applied to the select ungated packets step 108 and to the select gated packets step 110. The output of the select ungated packets 108 is applied to the subtract even/odd packets step 112. The output of the selected gate packets 110 is applied to the apply code key step 114. The CAC code key step 116 applies it's value to the apply code key step 114. the output of the apply code key step 114. The output of the apply code key step 114 is also applied to the subtract even/odd packets step 112. The output of the subtract even/odd packets step 112 ids applied to the RMGS autocorrelation step 118, whose output is also applied to the compute T matrix step 106. The output of the compute T matrix step 106 is then applied to the digital signal processor.

Page 106, the Brief Description of the Drawings Section:

Figure [A1]86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

Figure [A2]87 is a block diagram of a base station included in Figure [A1]86.

Figure [A3]88 is a flow diagram which implements the operation of the invention of Figures [A1 and A2]86 and 87.

Page 106, line 15 through page 107, line 2:

In Figure [A1]86, a remote station "X" and a remote station "Y" are coupled to a base station "Z" over a wireless link using traffic channels for data traffic, and a common access channel (CAC) and a common link channel (CLC) for control information. Each remote station includes a plurality of subscribers coupled to a transmitter/receiver which uses the discrete multitone spread spectrum protocol for transmissions. Communication between the remote stations and the base station is performed in the manner described in the above cited S. Alamouti et al. and E. Hoole et al. applications.

Page 109, line 6 through line 14:

In Figure [A2]87, a base station further includes a spectral and spatial despreading processor 312 which interacts with the spreading and despreading databases in accordance with the S. Alamouti et al. application previously cited. The processor is coupled to a decoder which provides an output to a vector disassembly buffer 316 for generating subscriber data originated in a call. The decoder is also coupled to a subscriber database buffer which contains information related to the subscriber name, number and other standard subscriber information including, for example, subscriber profiles. The output of the database buffer is provided to a call set up

processor 330 or an error processor 322 as will be described in more detail hereinafter. The processors 330 and 322 are connected to the network switch 202.

Page 109, line 15 through page 110, line 15:

The operation of Figures [A1 and A2] 86 and 87 will now be described in conjunction with Figure [A3]88. In step 710, a subscriber coupled to a remote station originates a call which initiates an "off hook" condition at the station. A set up connection request is initiated by the remote station in a step 720. The remote station transmits setup request message; the remote station ID and subscriber line number to the base station using a CAC tone. The base station responds to the set up connection request in step 730 and accesses the database 320 to identify the subscriber and obtain the subscriber profile. Simultaneously, in steps 740 and 743, the base station initiates the establishment of a traffic channel to the remote station and sends the set up request; remote user ID, subscriber line number and subscriber profile to the network switch 202. The network switch initiates the set up in a step 745 and provides dial tone to the subscriber at the remote station. During the process of establishing the traffic channel, the base station performs a test in a step 742 to determine whether a traffic channel has been established between the remote station and the base station. In some instances, the radio propagation characteristics of the channel are such that a link cannot be established. In the event that a link cannot be established, a "no" condition from the test 742 activates the error processor 322 which provides the network switch in a step 744 with a signal to a logic device which signals the network switch to disassemble or "tear down" the call set up in the PSTN, if the base station has sent the set up request message. In response to the logic device signal, the network switch in a step 749 "tears down" the PSTN connections and the process ends. In the instance where the traffic channel is

completed, a "yes" condition sends a signal to a logic device whereupon the network switch completes the call in a step 747, provided the call setup has been initiated and dial tone provided to the subscriber by the network switch.

Page 117, the Brief Description of the Drawings Section:

Figure [B1]89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

Figure [B2]90 is an architectural diagram of the remote station X as a sender.

Figure [B3]91 is an architectural diagram of the base station Z as a receiver.

Figure [B4]92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

Figure [B5]93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

Figure [B6]94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

Page 118, line 1 through line 22:

Figure [B1]89 is an architectural diagram of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent application. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna

elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure B1 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

Page 120, line 15 through page 121, line 11:

The following describes the operation of the remote station X in sending system management messages to the base station Z. The remote station and the base station are part of a wireless discrete multitone spread spectrum communications system. The remote station, which

is the sending station in this example, includes a priority message processor 204 shown in Figure [B2]90 and in Figure [B4]92, that selects the order in which system management messages are transmitted over the link control channel (LCC). The order of selection is by the time criticality of the message. Those messages having a greater time criticality are selected to be transmitted first. The priority message processor 204 in the sending station is programmed by program 400 of Figure [B4]92, to rank call control messages, connect messages, acknowledgement messages for call control, and signaling messages, for example, to have a greater time criticality than system status messages or software downloads have. The burst size transmitted from a sending station is a fixed number of bits long, for example forty-eight bits in length. If the message to be sent is longer than the burst size, then the priority message processor 204 at the sending station uses the priority message buffer 420 in Figure [B4]92, to break the message into segments. In accordance with the invention, a priority interrupt flag "P" of one bit in length is included with each message segment, to identify whether the segment is the first occurring segment in a message. A first segment of a message, with a priority interrupt flag bit P = 1, will be sent in a first occurring transmit burst time. The remaining segments that are not the first segment of a message, those segments with a priority interrupt flag bit P = 0, will be sent in a later occurring transmit burst times. This enables the sending station and the receiving station to cooperate in managing the communication of system management messages having differing time criticality.

Page 122, lines 11 through 22:

In accordance with the invention, the base station Z of Figure [B3]91 receives the burst with the first spread signal and the second spread signal. The base station adaptively despreads the first spread signal received by using despreading weights in the spectral and spatial

despreading processor 312, recovering the data portion. The base station also adaptively despreads the second spread signal received by using despreading weights, recovering the message segment portion and the priority interrupt flag portion. The base station includes a priority message processor 320 shown in Figure [B3]91 and in Figure [B6]94, that receives from the link control channel, the first message segment of the call control message. The priority message processor 320 at the base station then resets a message segment buffer 322 in the base station and stores the first segment of the call control message in the buffer 322, if the priority interrupt flag "P" has a first value of one. The first value of one for the priority interrupt flag "P" corresponds to a time critical message segment. This operation effectively substitutes the more time critical call control message for the first, status message at the base station Z.

Page 123, lines 7 through 20:

In an alternate embodiment of the invention, the base station's priority message processor 320 of Figure [B6]94, selectively reassigns its message processing capacity from low priority messages it is currently transmitting, to more time critical messages that it receives on the link control channel. In accordance with the invention, the base station Z is currently transmitting a transmitted spread signal comprising an outgoing data traffic signal spread over a plurality of discrete traffic frequencies and an outgoing message segment signal spread over a plurality of link control frequencies. This takes place during the transmit interval of a time division duplex session with the remote station X. The outgoing message segment signal from the base station is part of a low priority message, such as a software download to the remote station. During the next receive interval of the time division duplex session, the base station Z receives a spread signal comprising an incoming data traffic signal spread over a plurality of discrete traffic

frequencies and an incoming message segment signal spread over a plurality of link control frequencies. The base station adaptively despreads the signals received at the base station by using despreading weights in its spectral and spatial despreading processor 312 of [figure B3]Figure 91. Then the base station's priority message processor 320 of Figure [B6]94, detects a priority interrupt flag value "P" in the message segment signal.

Page 123, line 21 through page 124 line 19:

In accordance with the alternate embodiment of the invention, the base station's priority message processor 320 acts to reassign the station's message processing capacity by interrupting the next scheduled transmission of the second outgoing message segment signal. An example where this operation is required is when the remote station X sends a call control message to the base station that requires the base station to quickly respond with a reply message. The priority message processor 320 detects the priority interrupt flag P = 1 in the first segment of the call control message, and in response, resets the message segment buffer 322 in the base station. The priority message processor 320 stores the incoming message segment signal in the message segment buffer 322. The priority message processor 320 of Figure [B6]94, determines that the call control message received from the remote station requires a quick reply. In response to this, the priority message processor 320 at the base station stores the last segment number sent for the low priority outgoing message it has been sending to the remote station. The base station can then transmit its reply message to the remote station. In this manner, quick reply message can be sent in response to request messages. After the reply message has been sent by the base station, the last segment number sent for the low priority outgoing message is retrieved by the priority message processor 320 and transmission is resumed by the base station, starting with the

next segment number for the low priority outgoing message. Alternately, the base station concatenates the incoming message segment signal with a previously received message segment, if the priority interrupt flag has a second value of zero. The second value of zero for the priority interrupt flag corresponds to a message segment that is not a first message segment in a message having plural segments. In this manner, the invention manages the exchange of system management messages over the link control channel between a remote station and the base station so that time critical system management messages are given priority over those that are not time critical.

Page 124, line 20 through page 125, line 6:

In Figure [B2]90, Alice and Bob each input data to remote station X. The sender's traffic data is sent to the vector formation buffer 202 and the sender's system management information is sent to the priority message processor 204, shown in greater detail in Figure [B4]92. Data vectors are output from buffer 202 to the trellis encoder 206. The data vectors are in the form of a 48-bit data message segment per transmit burst. The LCC vectors output from the priority message processor 204 to the trellis encoder 206 are in the form of a 48-bit priority message segment per transmit burst, formed by concatenating a 47-bit message segment with the one-bit priority interrupt flag. The trellis encoded data vectors and LCC vectors are then output to the spectral spreading processor 208. The resultant data tones and LCC tones are then output from processor 208 to the transmitter 210 for transmission to the base station.

Page 125, lines 7 through 13:

The first four steps in the flow diagram 700 of Figure [B5]93 show the steps at remote station X when it is the sender. The steps in the method of transmission from a remote station

to a base station are first for the Remote Station in step 710 to generate a priority message segment in the priority message processor 204 of figure [B4]92 and input it as a vector to the link control channel. Then in step 720, the Remote Station performs trellis encoding of the link control channel vector and the data vectors. Then in Step 730, the Remote Station performs spectral spreading of the trellis encoded link control channel vector and data vectors. Then in Step 740, the Remote Station transmits the link control channel tone and data tones to the base station.

Page 127, lines 6 through 13:

Figure [B3]91 is an architectural diagram of the base station Z as a receiver. The data tones and LCC tones are received at the base station antennas A, B, C, and D. The receiver 310 passes the data tones and the LCC tones to the spectral and spatial despreading processor 312. The despread signals are then output from the processor 312 to the trellis decoder 314. The data vectors are then output to the vector disassembly buffer 316. The LCC vectors are output to the priority message processor 320, shown in greater detail in Figure 94. Alice's data and Bob's data are output from the buffer 316 to the public switched telephone network (PSTN). Priority message segments are passed from the priority message processor 320 to the priority message buffer 322. There the segments are concatenated into a full message 325 to be output on line 330.

Page 127, line 14 through page 128, line 2:

The last five steps in the flow diagram 700 of Figure [B5]93, show the base station Z as the receiver. In Step 750, the Base Station performs spectral and spatial despreading of the link

control channel tone and data tones. Then, in Step 760, the Base Station performs trellis decoding of despread link control channel tone and data tones. Then in Step 770, the Base Station's priority message processor 320 determines if the priority interrupt flag P = 1. If it does, then priority message processor 320 resets the priority message buffer 322 and loads the newly received message segment in buffer 322. In step 780, alternately, if the Base Station's priority message processor 320 determines that the priority interrupt flag P = 0, then it concatenates the newly received message segment with the previously received message segment for the same message in buffer 322. Then in Step 790, the priority message buffer 322 combines the plural message segments into a complete message and outputs it on line 330. The completed message can be processed within the base station or it can be forwarded along with the received data to the public switched telephone network.

Page 133 to 134, the Brief Description of the Drawings:

Figure [C1A]95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

Figure [C1B]96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

Figure [C2]97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

Figure [C3]98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

Figure [C4]99 is a flow diagram of the sequence of operational steps for the invention.

Page 134, line 5 to page 135, line 19:

Figure [C1A]95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel. Figure [C1B]96 shows the remote station transmitting a functional quality and maintenance message to the base station over the common access channel. These are diagrams of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent applications. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure [C1]95 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the

users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

Page 137, lines 10 through 20:

In accordance with the invention, a new method makes the most efficient use of the scarce spectral bandwidth in a wireless discrete multitone spread spectrum communications system. Each remote station in the network collects functional quality and maintenance data for itself. During each data traffic session that a remote station has with the base station, the remote station X of Figure [C2]<u>97</u> computes the signal-to-interference-and-noise ratio (SINR) as a byproduct of receiving the discrete multitone spread spectrum signals from the base station Z. The remote station stores the SINR data that it accumulates in a SINR history buffer 224. The remote station also computes the path loss of the signals received from the base station and stores the values it accumulates in a path loss history buffer 226. The remote station runs self-test programs on a periodic basis and stores the results in a self-test results buffer 220. And the remote station monitors the status of its backup battery and stores the status in a battery status

buffer 222. Other functional quality and maintenance data can also be monitored by the remote station and stored in buffers.

Page 137, line 21 through page 138, line 11:

In accordance with the invention, the base station Z periodically transmits a discrete multitone spread spectrum (DMT-SS) signal on the common link channel to each remote station, polling the respective remote station, as shown in Figure [C1A]95. The common link channel (CLC) is used by the base to transmit control information to the remote stations. Simultaneously, data traffic from the public switched telephone network (PSTN) arrives at the base station Z and is converted into data traffic DMT-SS tones which are transmitted to the remote stations. In response to the base station's polling signal being received by the remote station X at its input 230, the respective remote station of Figure [C2]97, activates its polling response processor 228 to respond the poll. The polling response processor 228 accesses the self test buffer 220, the battery status buffer 222, the SINR history buffer 224, and the path loss buffer 226 to assemble a functional quality and maintenance data message. The message is formed into a common access channel vector that is input to the trellis encoder 206 and then to the spectral spreading processor 208 to produce the common access channel tone. The common access channel tone with the functional quality and maintenance data message is then transmitted by transmitter 210 as a DMT-SS signal back to the base station Z on the common access channel.

Page 138, line 20 through page 139, line 3:

When the base station Z of Figure [C3]98 receives the functional quality and maintenance message on the common access channel tone from the remote station X that it has polled, it performs spectral and spatial despreading of the signal in the spectral and spatial

despreading processor 312 and trellis decoding of the signal in the trellis decoder 314 to obtain a common access channel vector bearing the functional quality and maintenance data. The functional quality and maintenance data are then stored in the functional quality and maintenance archive buffer 320, organized by each responding remote station.

Page 141, line 9 through page 142, line 3:

Figure [C4]99 is a flow diagram 700 of the sequence of operational steps for the invention. In step 710, the remote station monitors and buffers the functional quality data, including the SINR and path loss for sessions with the base station. In step 720, the remote station monitors and buffers the maintenance data, including self-test results and battery status, for the remote station. In step 730, the base station transmits a polling signal on the common link channel tone to the remote station. In step 740, the remote station accesses the functional quality data and the maintenance data from its buffers, assembles the data into a message vector, and transmits it on the common access channel tone to the base station. The remote station simultaneously transmits data traffic channel tones to the base station. In step 750, the base station performs spectral and spatial despreading of the common access channel tone and the data traffic tones. In step 760, the base station performs trellis decoding to recover the common access channel vector bearing the functional quality and maintenance message. In step 770, the base station archives the functional quality and maintenance data. In step 780, the base station analyzes the functional quality data and updates the despreading and spreading weights to maximize the quality of the channels it establishes with the remote station. In step 790, the base station analyzes the maintenance data and outputs maintenance notices to repair or replace failing components at the remote station. In this manner, functional quality and maintenance

data can be communicated from the remote stations to the base station without adversely affecting the transmission of messages having greater time criticality.

Page 153, in the Brief Description of the Drawings:

FIGURE [D1A]100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE [D1B]101 is an architectural diagram of the personal wireless access network (PWAN) of Figure [D1A]100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

Page 153, line 12 through 17:

Figure [D1A]100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y. The signal received by the remote station X has a signal power level that is less than the prearranged initial forward signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The remote station stores the value of the channel loss it measures.

Page 154, line 1 through line 11:

Figure [D1B]101 is an architectural diagram of the personal wireless access network (PWAN) of Figure [D1A]100, showing the remote station X transmitting reverse pilot tones with

a prearranged initial reverse signal power level, to the base station Z. The signal received by the base station Z has a signal power level that is less than the prearranged initial reverse signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The base station stores the value of the channel loss it measures. The base station includes a retrodirective power management unit. The base prepares despreading weights to despread the DMT-SS signals it receives from the remote station X. Then the base uses the principle of retrodirectivity to compute spreading weights for transmission of DMT-SS signals to the remote station X. The spreading weights calculated at the base station include a factor based on the measured channel loss stored at the base station, to overcome the channel loss so that forward signals transmitted to the remote station X will arrive there with a desired received signal power level.

Page 155, line 1 through page 156, line 5:

Figure [D1A]100 illustrates the personal wireless access network (PWAN) system described in the referenced Alamouti, et al. patent application. Two users, Alice and Bob, are located at the remote station X and will exchange their respective data messages with the base station Z. Station X is positioned to be equidistant from the antenna elements A and B, of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also will exchange their respective data messages with the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A and B of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum (DMT-SS) to provide efficient communications between the base station and the plurality of remote station units. This protocol

is designated in Figure [D1A]100 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location. The PWAN system has a total of 2560 discrete tones (carriers) equally spaced in 8 MHz of available bandwidth in the range of 1850 to 1990 MHz. The spacing between the tones is 3.125 kHz. The total set of tones are numbered consecutively form 0 to 2559 starting from the lowest frequency tone. The tones are used to carry traffic messages and overhead messages between the base station and the plurality of remote units. The traffic tones are divided into 32 traffic partitions, with each traffic channel requiring at least one traffic partition of 72 tones.

Page 177, in the Brief Description of the Drawings:

Figure [E1A]102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Figure [E1B]103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

Figure [E1C]104 is a network diagram of the four cells similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Figure [E2A]105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

Figure [E2B]106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

Page 178, line 2 through line 9:

Figure [E1A]102 is a network diagram of two cells 1 and 2, in a PWAN communications system. Base station B1 communicates with remote stations R1 and R1' using the DMT-SS protocol. The notation (B1->R1') indicates the path from base station B1 to the remote station

R1', for example. The notation (R1'->B1) indicates the path from remote station R1' back to the base station B1. The notation (R2->B1) indicates the path from remote station R2 in the neighboring cell 2 to the base station B1. Base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. In accordance with the invention, base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Page 178, line 10 through 19:

Figure [E2A]105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1. Remote station R1' in the same cell as base station B1, sends data tones and pilot tones to base station B1 using the DMT-SS protocol. Remote station R2 in the neighboring cell 2 sends an interfering signal to base station B1, also using the DMT-SS protocol. The base station B1 calculates optimum weights based on all of the signals received at the base station using the adaptive processor. Since the set of tone frequencies on the receive path is the same as the set of tone frequencies on the transmit path, the despreading weights used to receive can be used to compute the spreading weights for transmission, using the principle of retrodirectivity. The adaptive processor computes the value of the despreading weights, adjusted to minimize receive sensitivity to interfering signals from remote station R2.

Page 179, line 1 through 6:

Figure [E2B]106 is a detailed block diagram similar to Figure [E2A]105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2. The spreading weights derived from the despreading weights are also adaptive, their values being adjusted to diminish the strength of signals transmitted back in the direction of the interfering signal source, R2. Null steering and code nulling are used to adjust the despreading weights and the spreading weights to adaptively minimize the exchange of interfering signals.

Page 179, line 7 through 16:

Figure [E1A]102 shows base station B2 communicating with remote stations R2 and R2' using the DMT-SS protocol. Figure [E1B]103 is a network diagram of the two cells of Figure [E1A]102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength. When adaptive retrodirectivity is used to determine the set of weights for both reception and transmission in each cell of the network, network-wide adaptive retrodirectivity can be accomplished. The base stations and remote stations in each cell use null-steering and code nulling to diminish their interference with stations in other cells. The retrodirective formation of spreading weights from despreading weights in each station propagates channel optimization across cell boundaries.

Page 179, line 17 to 19:

Figure [E1C]104 is a network diagram of the four cells 1, 2, 3, and 4, similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Page 180, line 1 through 15:

Figure [E1A]102 also shows how the remote station R2 in cell 2 responds to the presence of interference signals it detects from the base station in cell 1, to optimize the multiple cell network for inter-cell interference. As was discussed above, base station B1 is receiving a first spread signal comprising a first data signal spread over a plurality of discrete tones received over a first path (R1'->B1) from remote station R1' located in cell 1. The first signal further includes an interfering signal spread over the plurality of discrete tones received over an interference path (R2->B1) from remote station R2 located in cell 2. Base station B1 is adaptively despreading the signal received by using first despreading codes that are based on the characteristics of the received spread signal over the first path (R1'->B1) and over the interference path (R2->B1). The base station B1 then is spreading a second data signal with first spreading codes derived from the despreading codes based on the retrodirectivity of the first path (R1'->B1) and of the interference path (R2->B1). The first spreading codes are distributing the second data signal over a plurality of discrete tones, forming a second spread signal that is selectively diminished in the interfering path (B1->R2) to the second remote station R2. Then base station B1 continues by transmitting the second spread signal over the first path (B1->R1') to the first remote station R1' and transmitting the second signal selectively diminished over the interference path (B1->R2) to the second remote station R2.

FIG. 1A

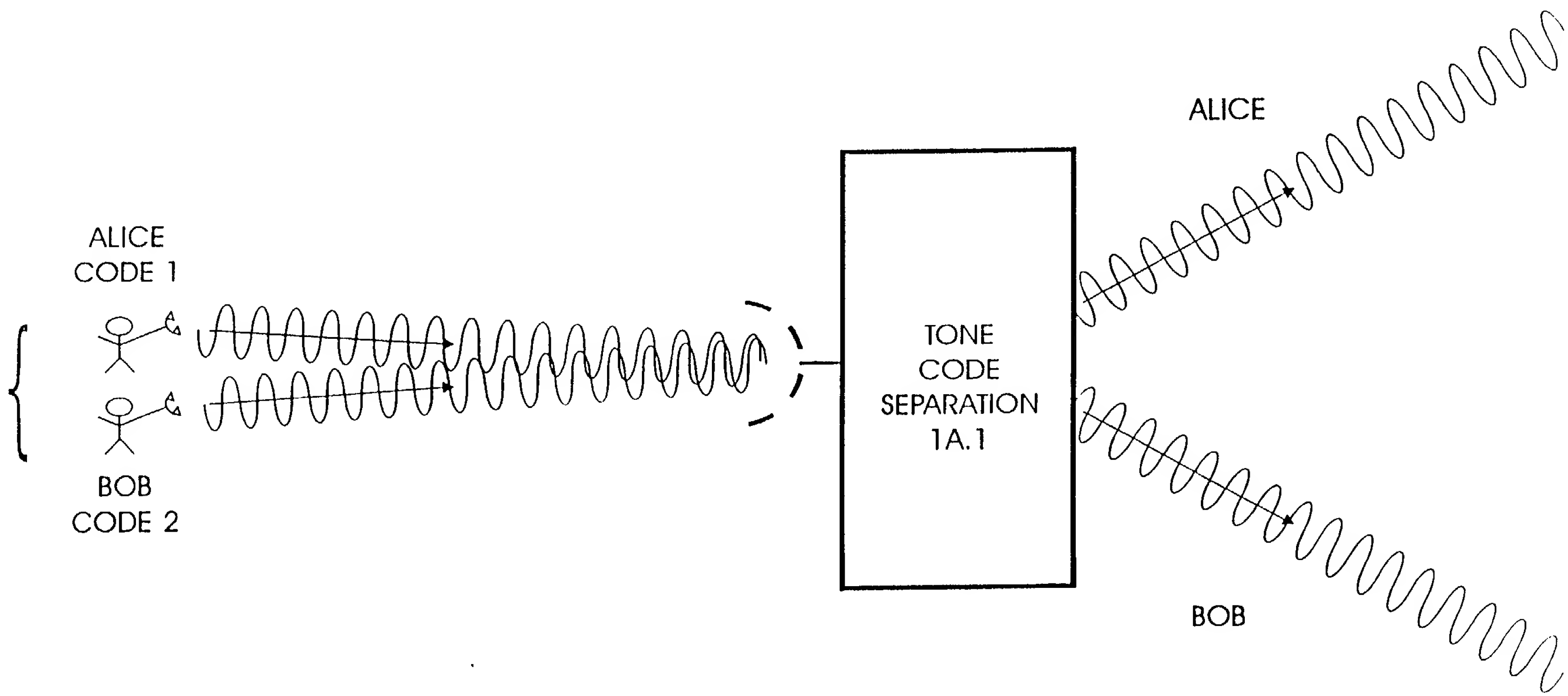


FIG. 1B

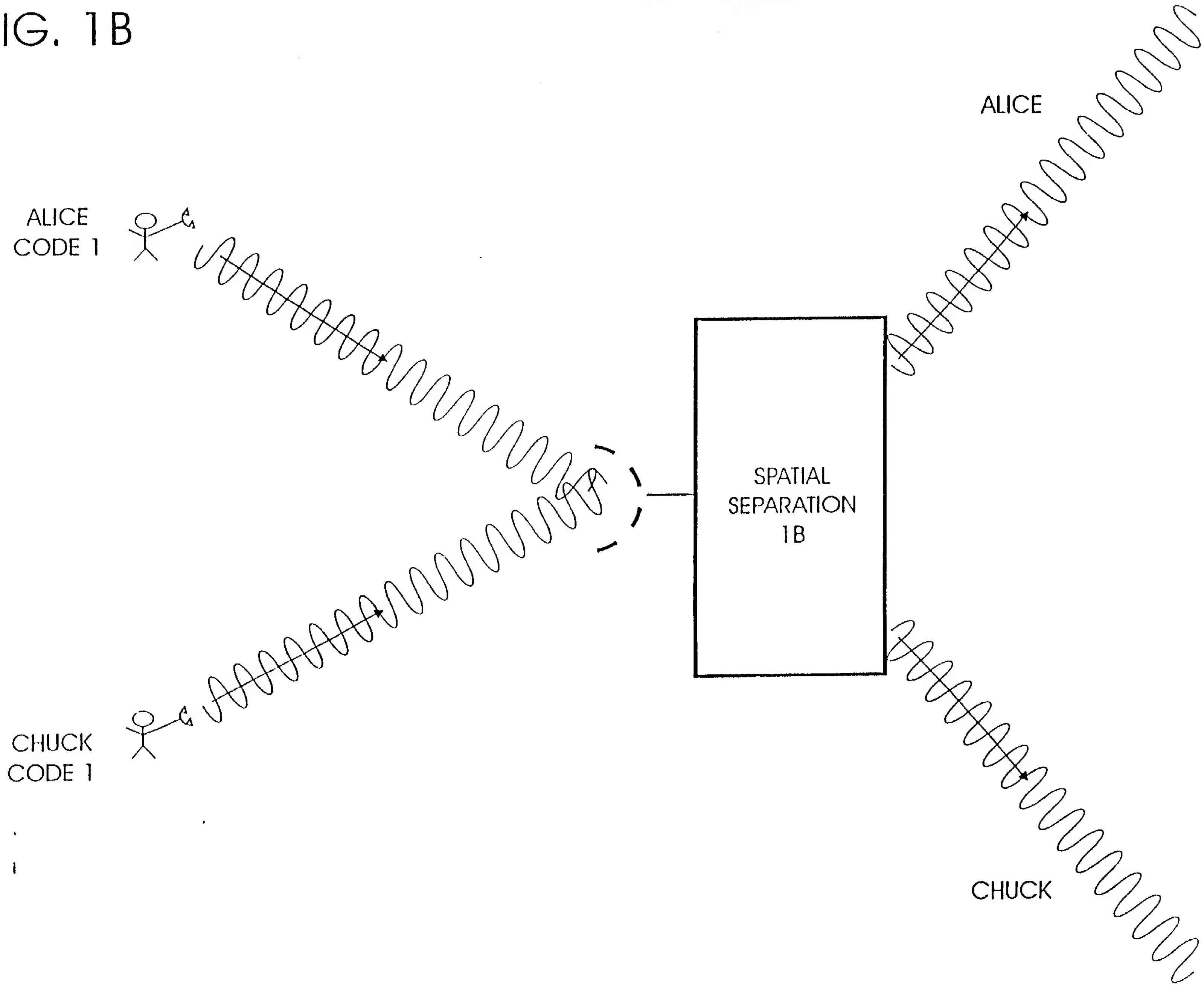
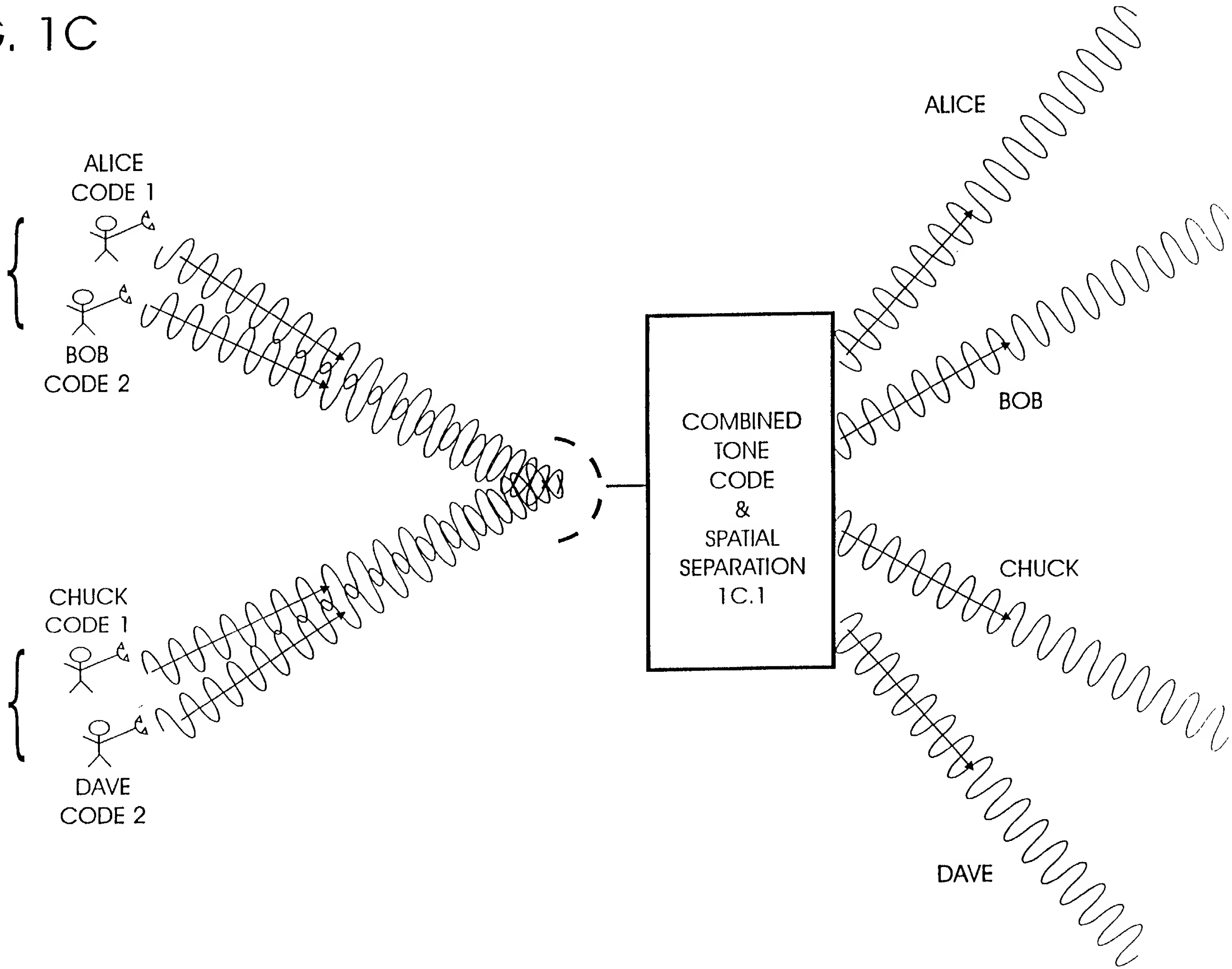


FIG. 1C


ALICE
CODE 1
BOB
CODE 2
CHUCK
CODE 1
DAVE
CODE 2
COMBINED
TONE
CODE
&
SPATIAL
SEPARATION
1C.1
ALICE
BOB
CHUCK
DAVE

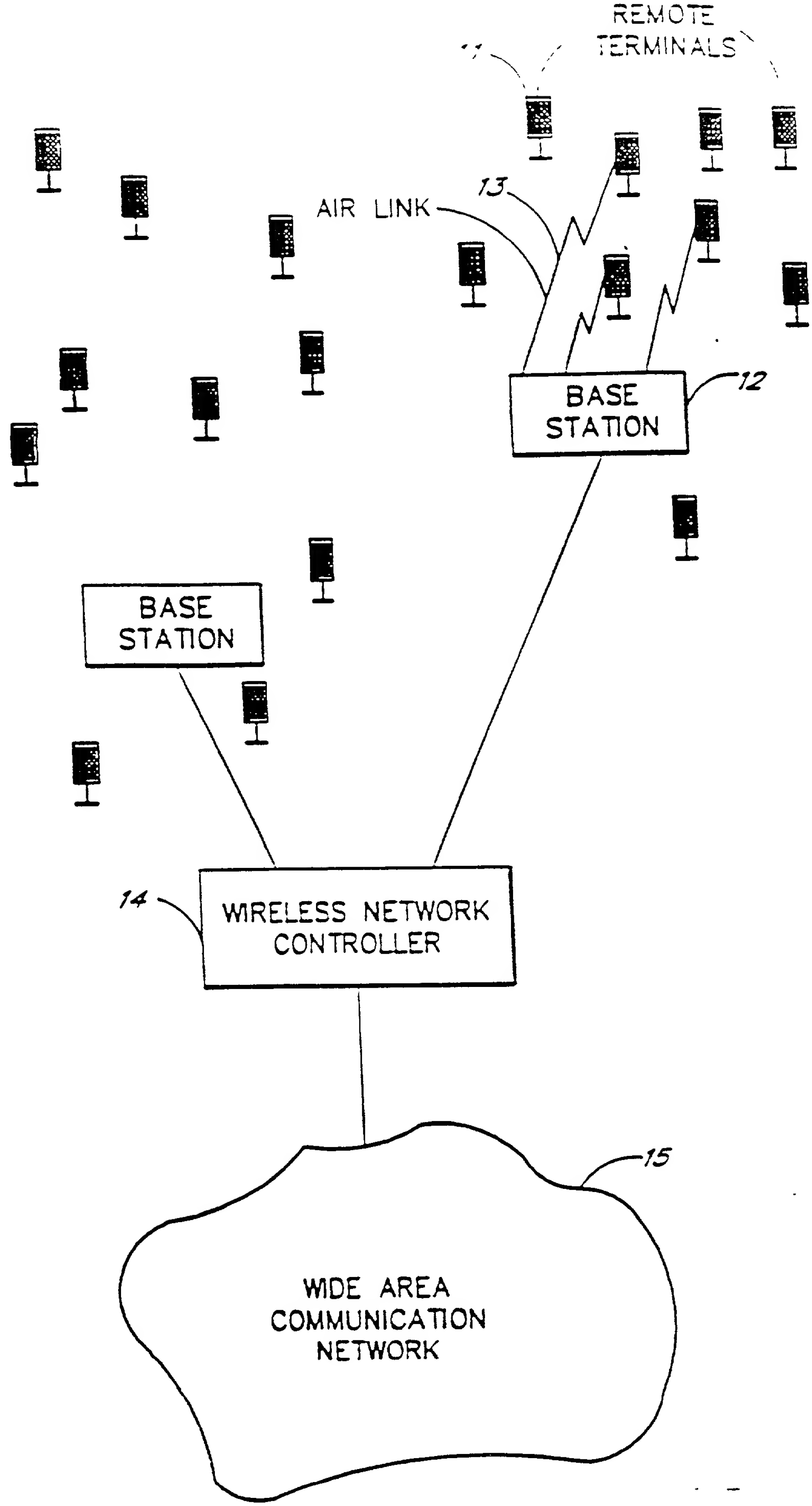

REMOTE TERMINALS
AIR LINK
13
BASE STATION
12
BASE STATION
14
WIRELESS NETWORK CONTROLLER
WIDE AREA COMMUNICATION NETWORK
15

FIG. 1D

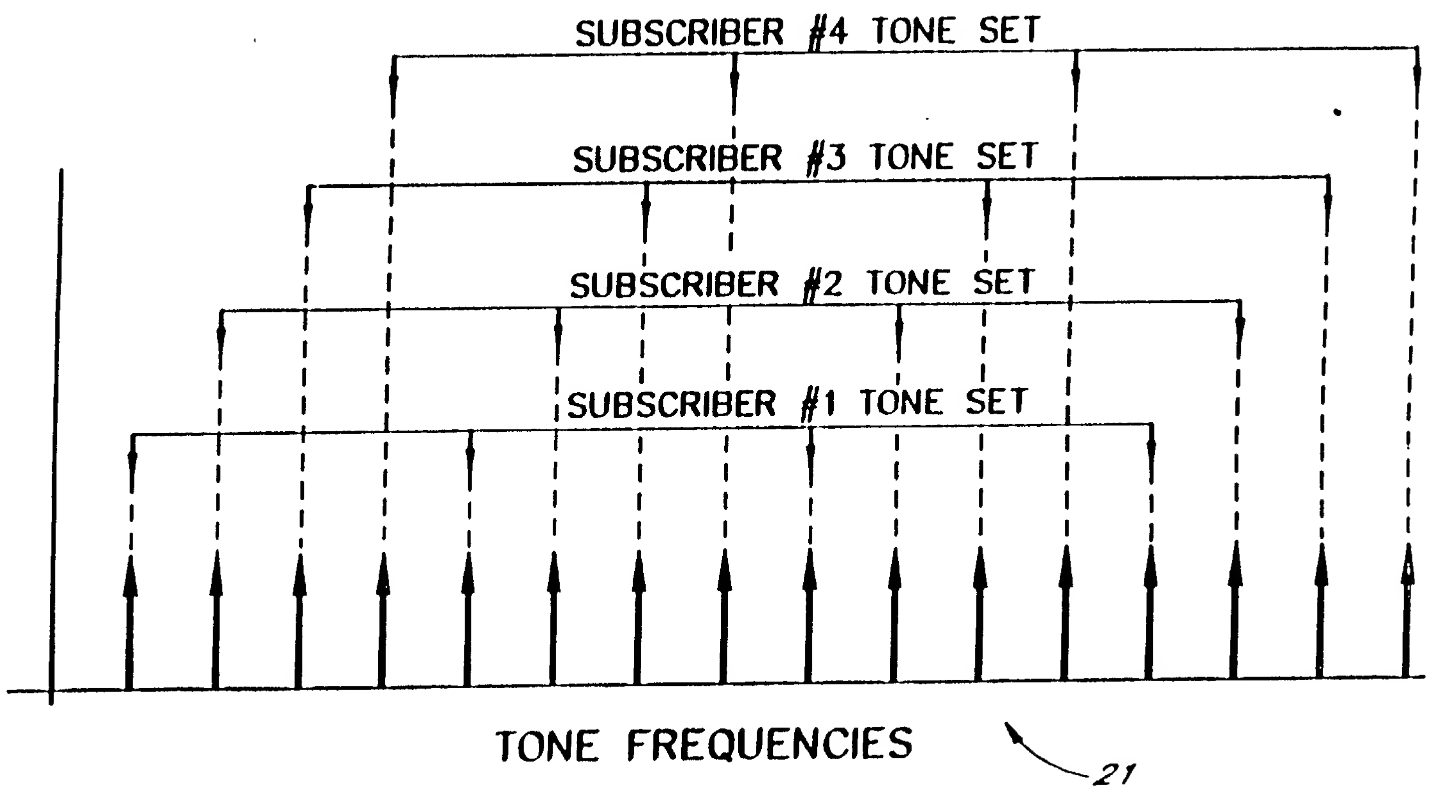

SUBSCRIBER #4 TONE SET
SUBSCRIBER #3 TONE SET
SUBSCRIBER #2 TONE SET
SUBSCRIBER #1 TONE SET
TONE FREQUENCIES
21

FIGURE 2

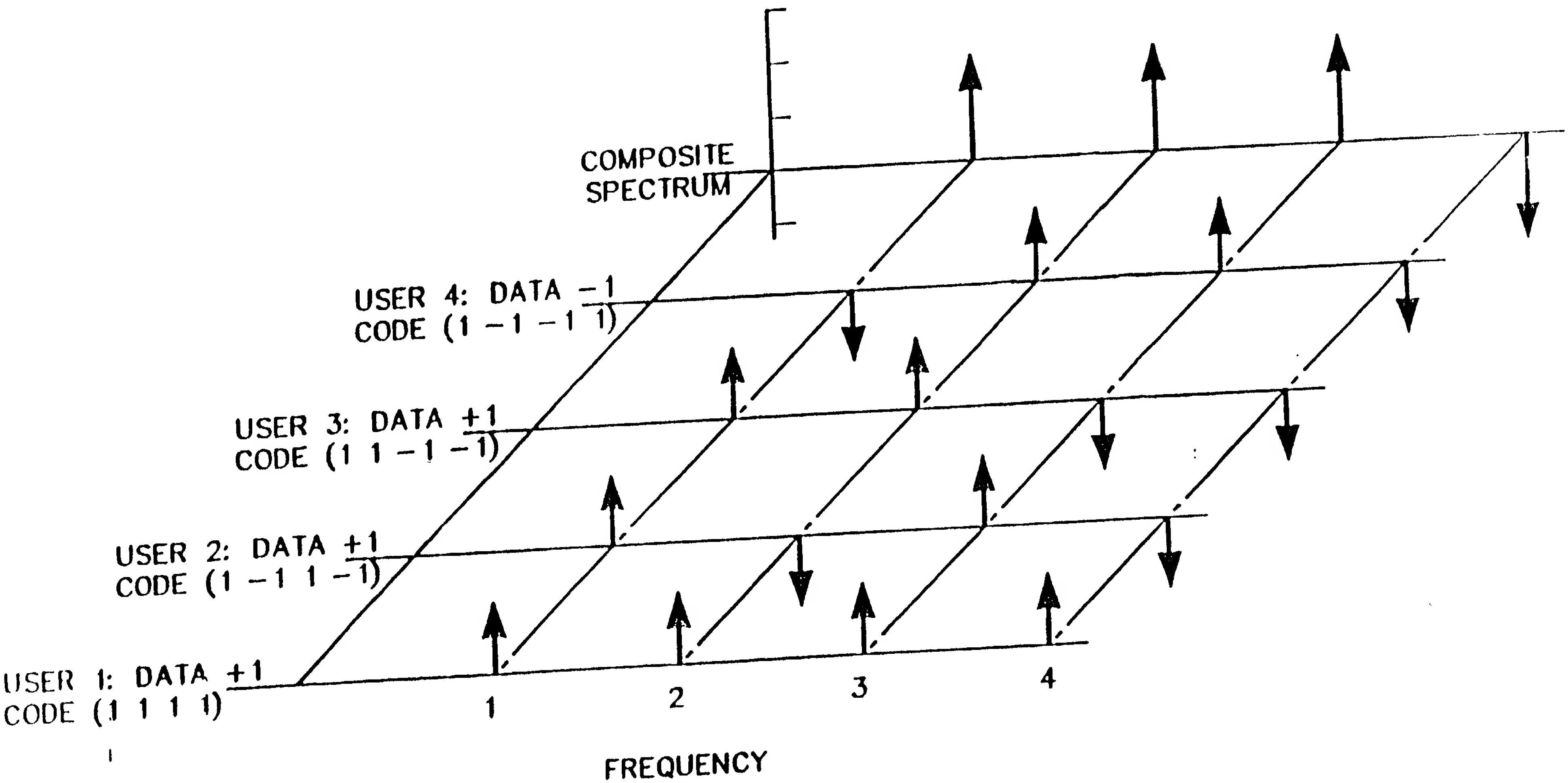
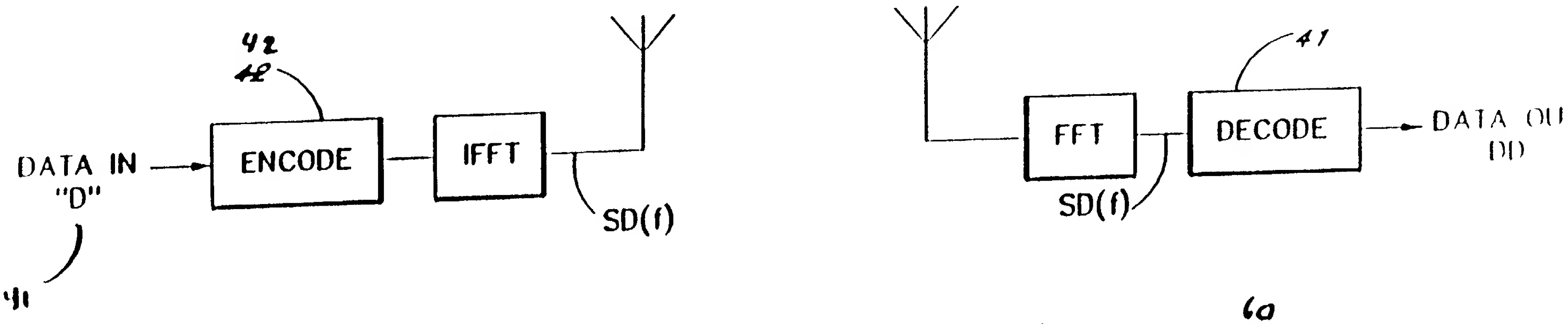

COMPOSITE
SPECTRUM
USER 4: DATA −1
CODE (1 −1 −1 1)
USER 3: DATA +1
CODE (1 1 −1 −1)
USER 2: DATA +1
CODE (1 −1 1 −1)
USER 1: DATA +1
CODE (1 1 1 1)
1
2
3
4
FREQUENCY

FIGURE 3



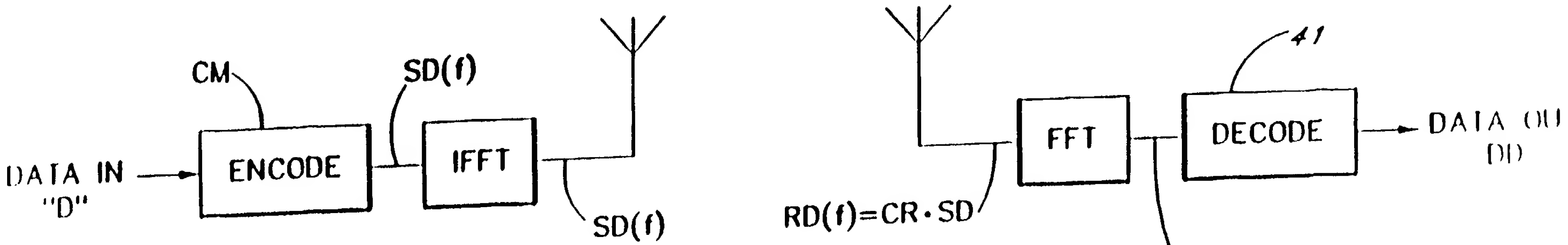
$$\underbrace{SD(f)=CM\cdot D}_{43}$$

$$\underbrace{DD(f)=CM^{-1}\cdot SD(f)}_{60}$$

$$SD(f)=\overset{47}{\begin{bmatrix}2\\2\\2\\-2\end{bmatrix}}=\underbrace{\overset{46}{\begin{bmatrix}1&1&1&1\\1&-1&1&-1\\1&1&-1&-1\\1&-1&-1&1\end{bmatrix}}\cdot\overset{45}{\begin{bmatrix}1\\1\\1\\-1\end{bmatrix}}}_{44}$$

$$DD=\overset{51}{\begin{bmatrix}1\\1\\1\\-1\end{bmatrix}}=\underbrace{\frac{1}{4}\overset{50}{\begin{bmatrix}1&1&1&1\\1&-1&1&1\\1&1&-1&-1\\1&-1&-1&1\end{bmatrix}}\cdot\overset{49}{\begin{bmatrix}2\\2\\2\\-2\end{bmatrix}}}_{48}$$

FIGURE 4



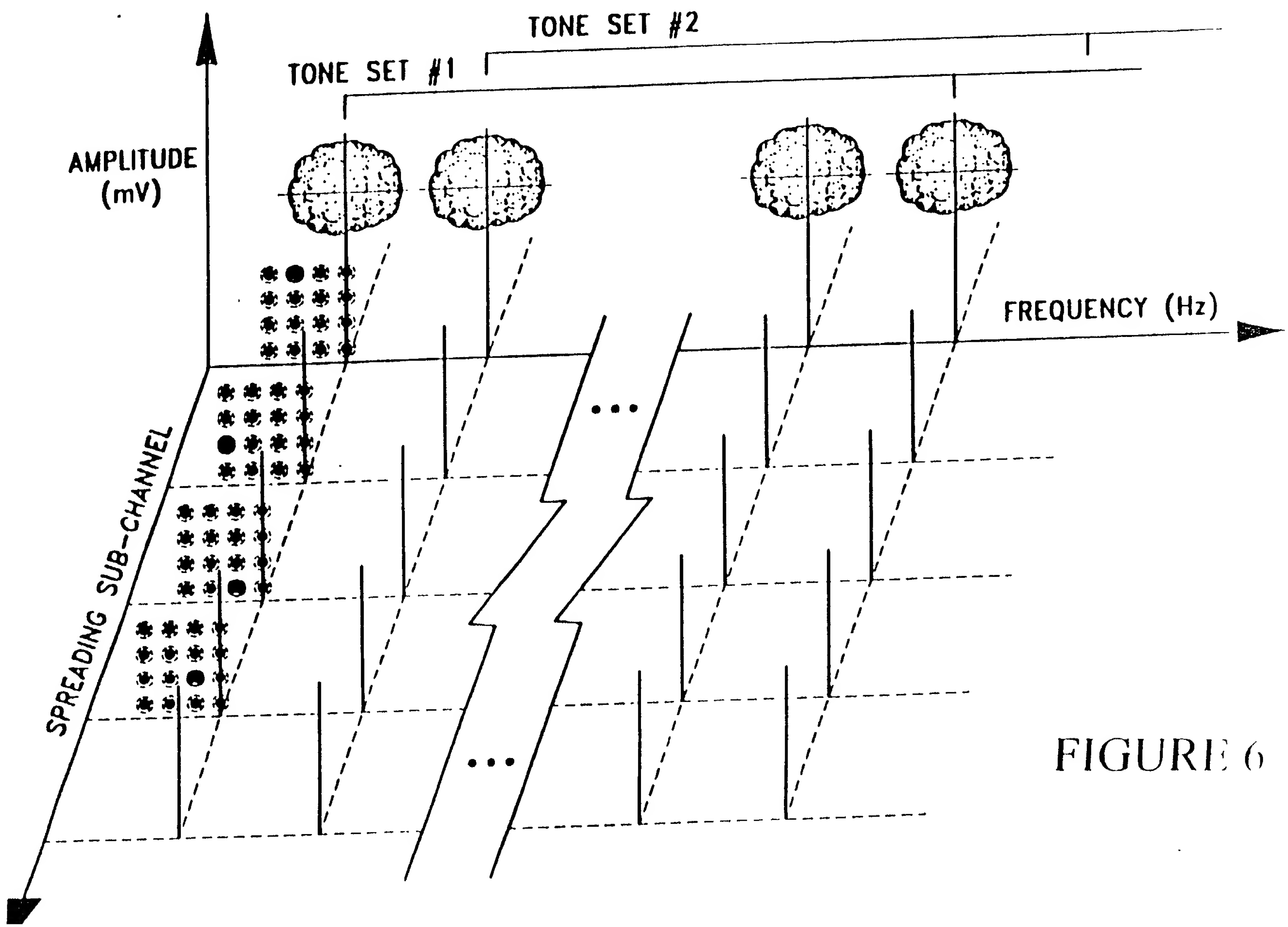
$$\underbrace{SD(f)=CM\cdot D}_{43}$$

$$\underbrace{RD(f)=CR(f)\cdot SD(f)}_{52}$$

$$RD=\underbrace{\begin{bmatrix}0.9\\1.0\\1.2\\1.1\end{bmatrix}}_{53}\cdot\begin{bmatrix}2\\2\\2\\-2\end{bmatrix}=\underbrace{\begin{bmatrix}1&1&1&1\\1&-1&1&-1\\1&1&-1&-1\\1&-1&-1&1\end{bmatrix}\cdot\begin{bmatrix}1\\1\\1\\-1\end{bmatrix}}_{44}$$

$$DD=\begin{bmatrix}1.0\\1.1\\0.9\\-1.2\end{bmatrix}=\frac{1}{4}\begin{bmatrix}1&1&1&1\\1&-1&1&+1\\1&1&-1&-1\\1&-1&-1&1\end{bmatrix}\cdot\begin{bmatrix}1.8\\2.0\\2.4\\-2.2\end{bmatrix}$$

FIGURE 5



TONE SET #2
TONE SET #1
AMPLITUDE (mV)
FREQUENCY (Hz)
SPREADING SUB-CHANNEL

FIGURE 6

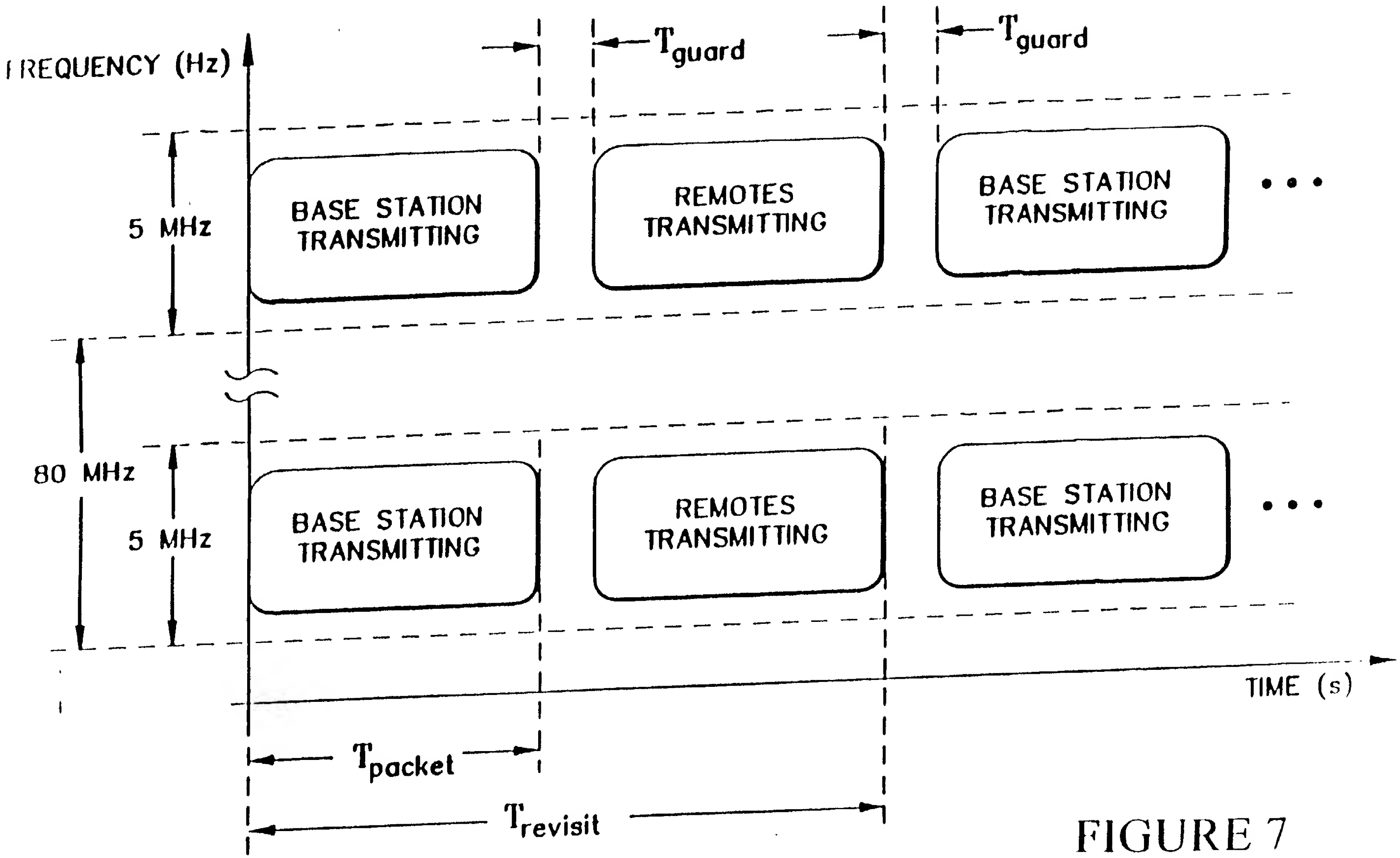

FREQUENCY (Hz)
T guard
T guard
5 MHz
BASE STATION TRANSMITTING
REMOTES TRANSMITTING
BASE STATION TRANSMITTING
80 MHz
5 MHz
BASE STATION TRANSMITTING
REMOTES TRANSMITTING
BASE STATION TRANSMITTING
TIME (s)
T packet
T revisit

FIGURE 7

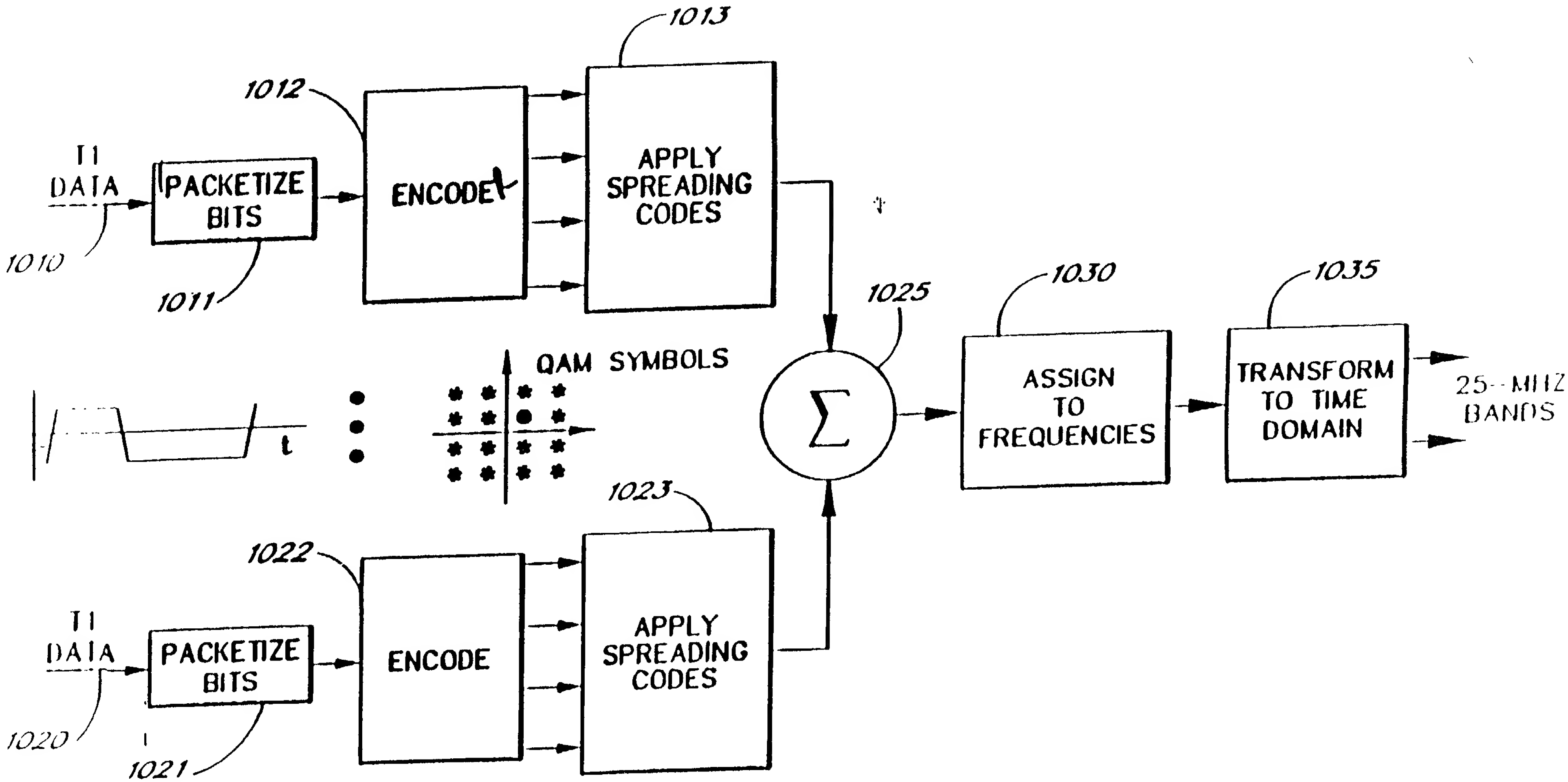

T1 DATA
1010
PACKETIZE BITS
1011
1012
ENCODE
1013
APPLY SPREADING CODES
t
QAM SYMBOLS
1022
1020
T1 DATA
PACKETIZE BITS
1021
ENCODE
1023
APPLY SPREADING CODES
1025
Σ
1030
ASSIGN TO FREQUENCIES
1035
TRANSFORM TO TIME DOMAIN
25-MHZ BANDS

FIGURE 8

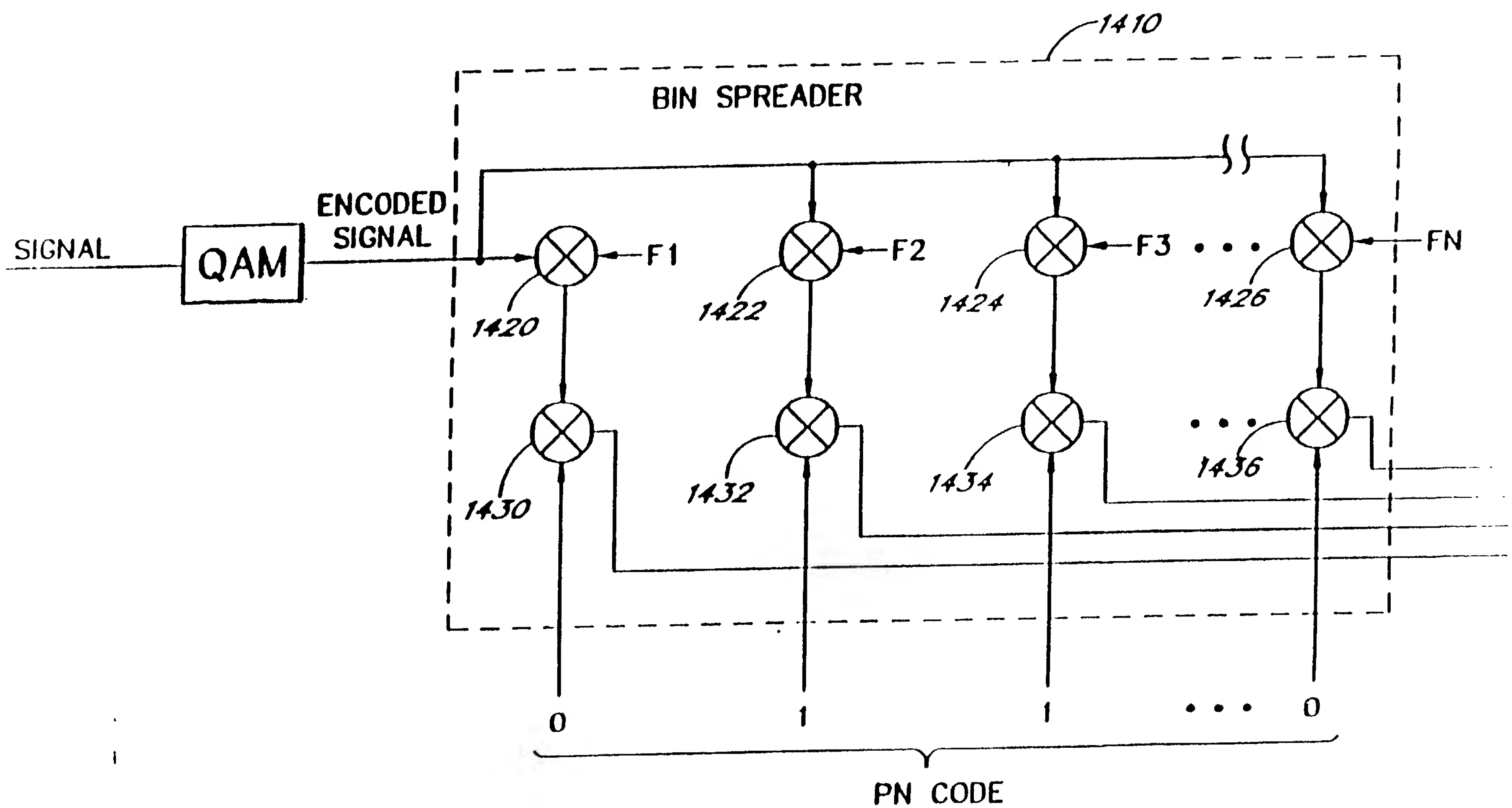
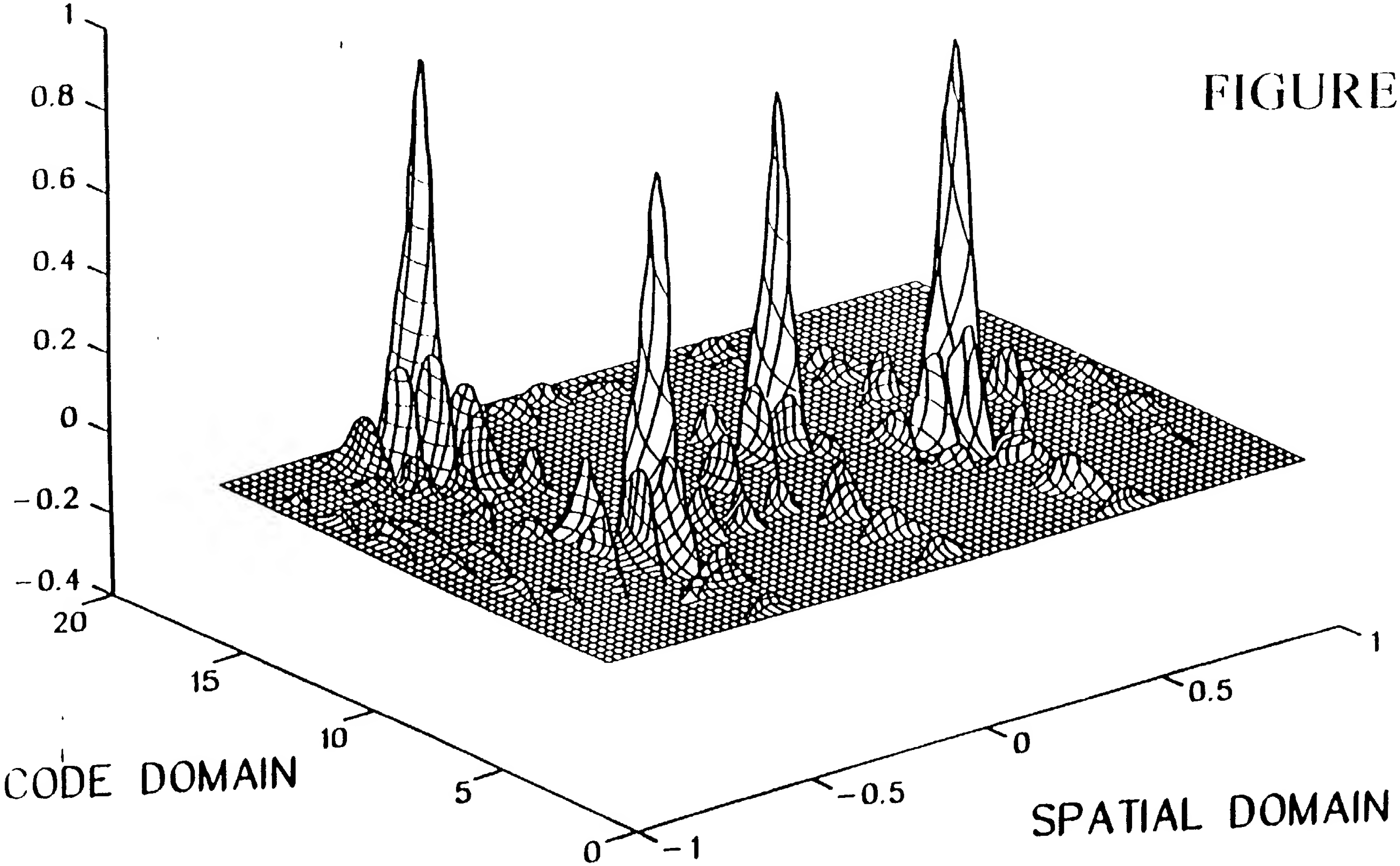

1410
BIN SPREADER
SIGNAL
QAM
ENCODED SIGNAL
F1
F2
F3
FN
1420
1422
1424
1426
1430
1432
1434
1436
0
1
1
0
PN CODE

FIGURE 9



1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
20
15
10
5
0
CODE DOMAIN
-1
-0.5
0
0.5
1
SPATIAL DOMAIN

FIGURE 10

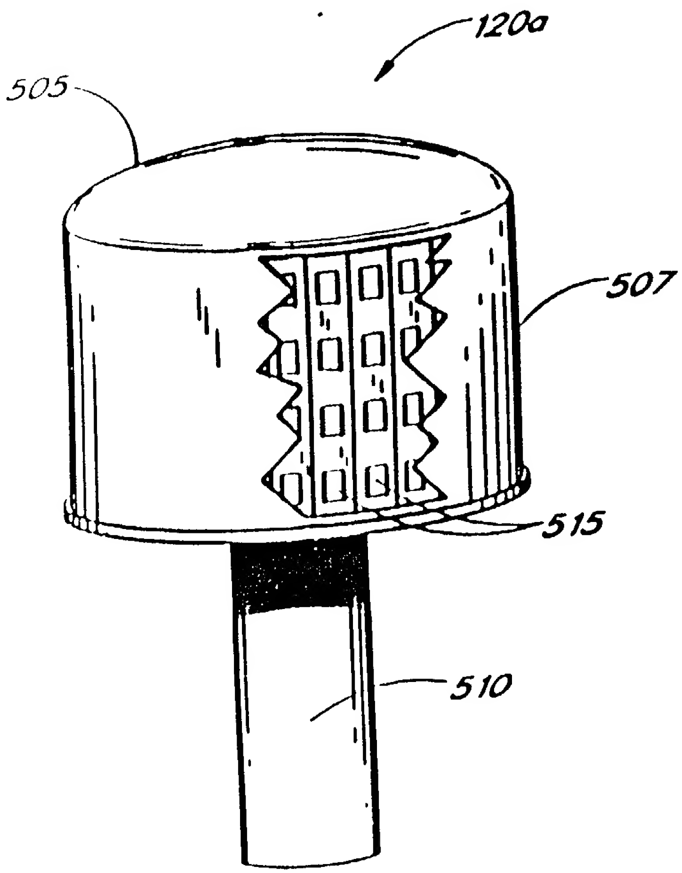


FIGURE 11

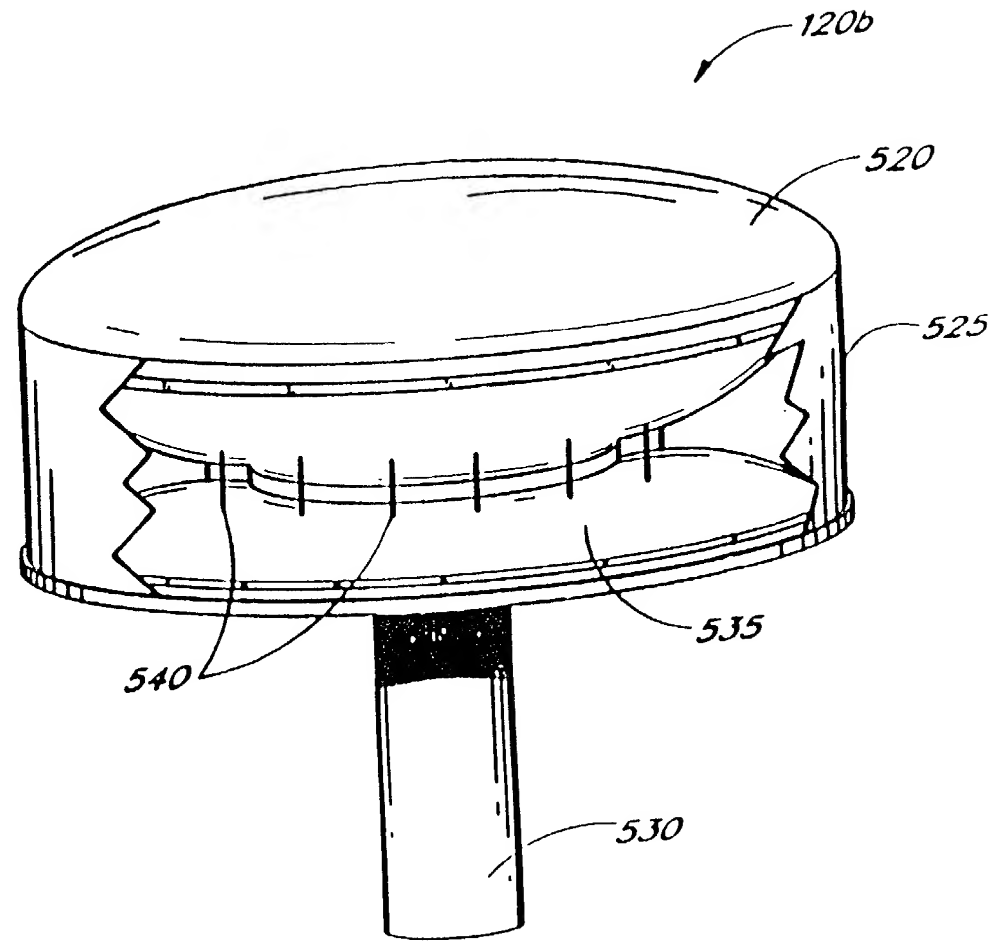


FIGURE 12

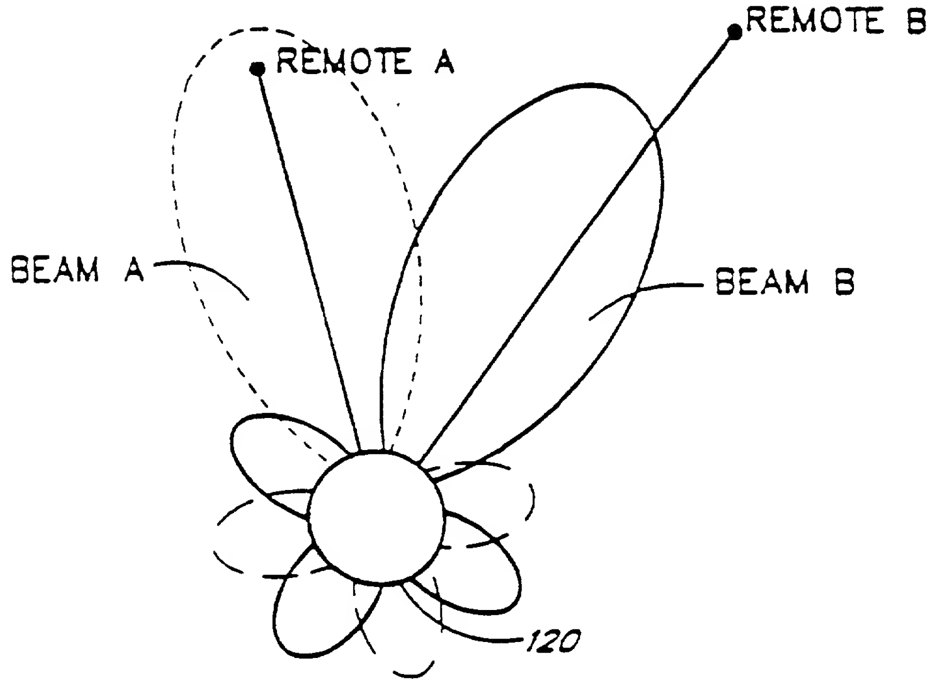


FIGURE 13

FIGURE 14

Inverse Frequency-Channelized Spreader Implementation

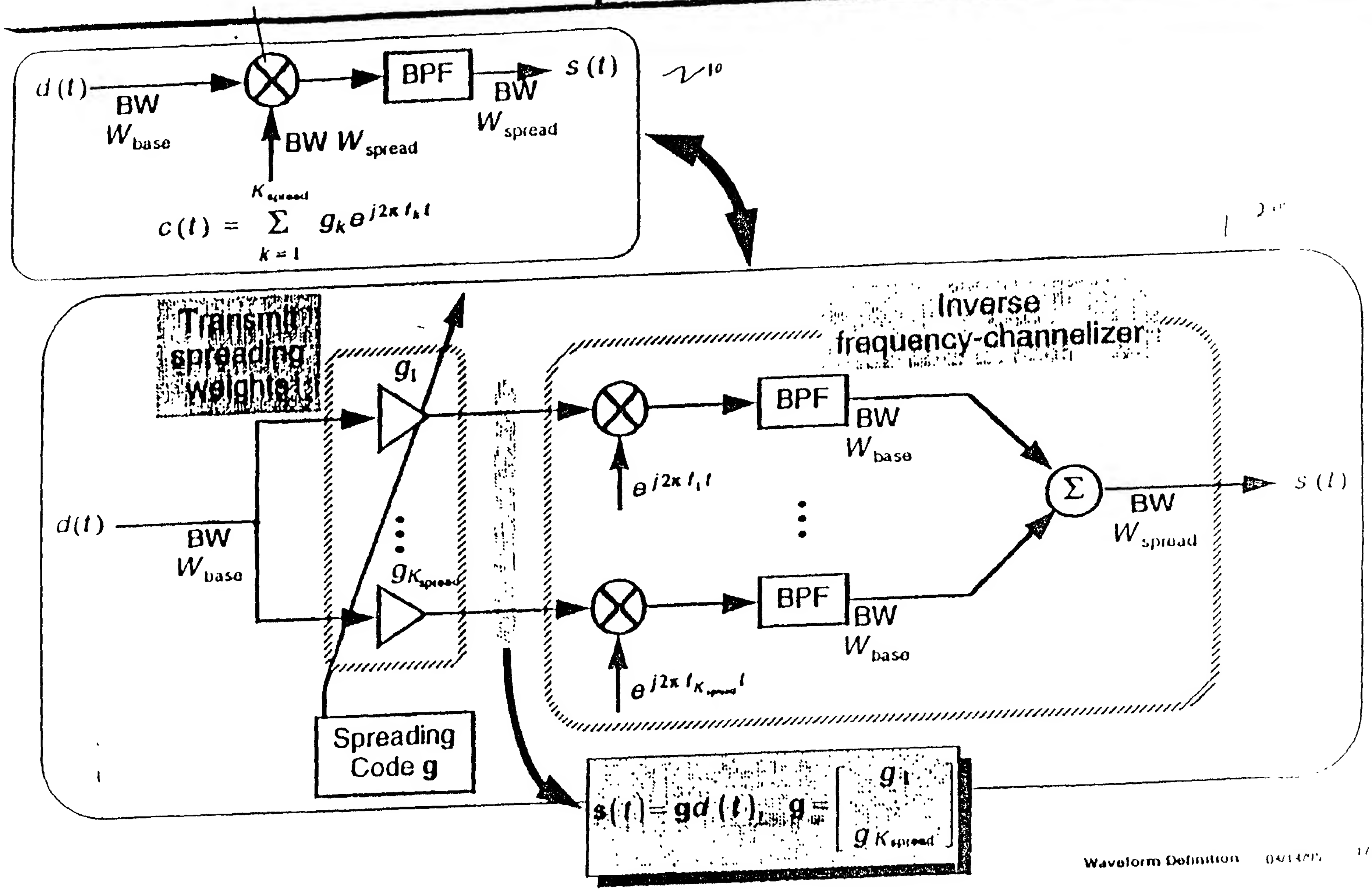
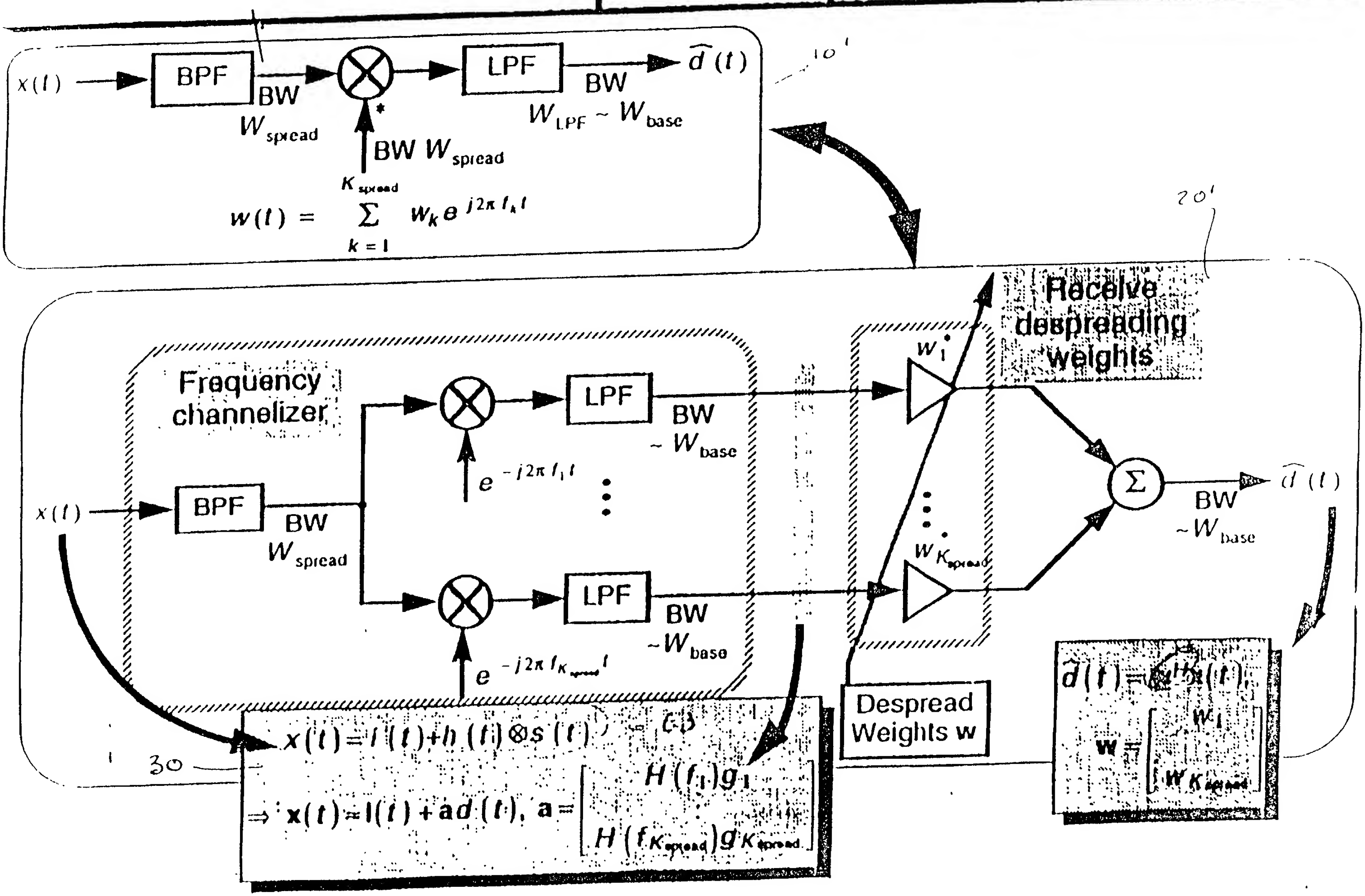


FIGURE 15

Frequency-Channelized Despreader Implementation



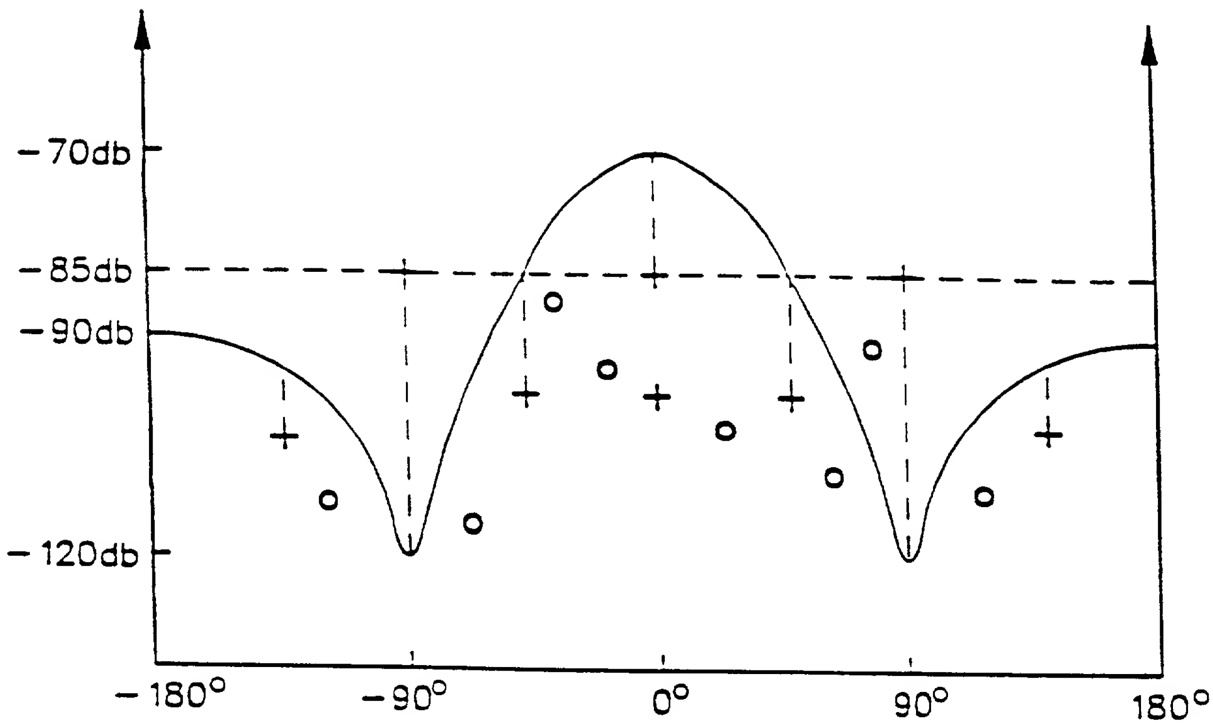


FIGURE 16

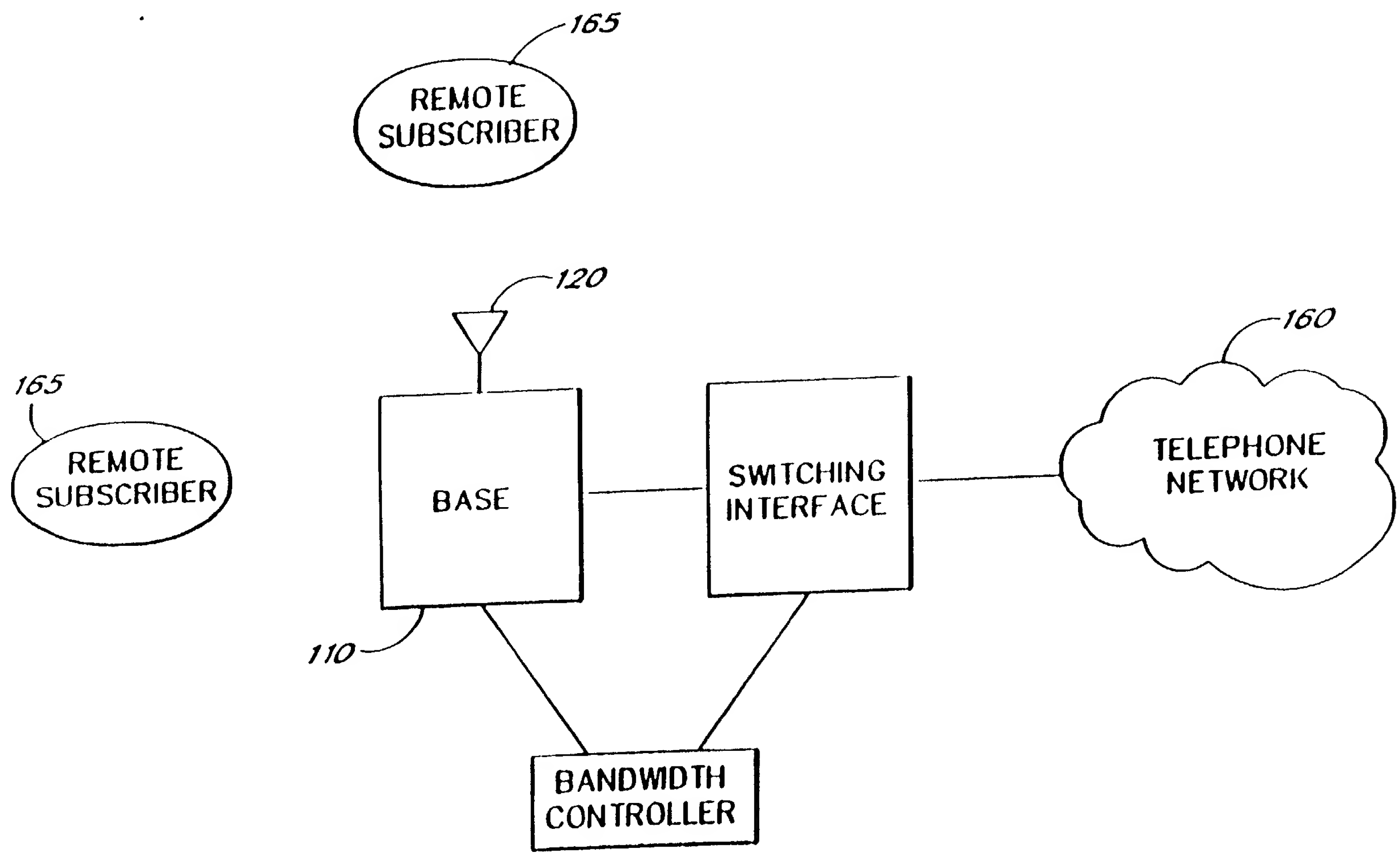

165
REMOTE SUBSCRIBER
165
REMOTE SUBSCRIBER
120
BASE
110
SWITCHING INTERFACE
BANDWIDTH CONTROLLER
160
TELEPHONE NETWORK

FIGURE 17

FIG. 18 *Possible Operational Frequency Bands for PWAN*

Base frequency	Lower RF band	Upper RF band
1850 MHz	1850-1855 MHz	1930-1935 MHz
1855 MHz	1855-1860 MHz	1935-1940 MHz
1860 MHz	1860-1865 MHz	1940-1945 MHz
1865 MHz	1865-1870 MHz	1945-1950 MHz
1870 MHz	1870-1875 MHz	1950-1955 MHz
1875 MHz	1875-1880 MHz	1955-1960 MHz
1880 MHz	1880-1885 MHz	1960-1965 MHz
1885 MHz	1885-1890 MHz	1965-1970 MHz
1890 MHz	1890-1895 MHz	1970-1975 MHz
1895 MHz	1895-1900 MHz	1975-1980 MHz
1900 MHz	1900-1905 MHz	1980-1985 MHz
1905 MHz	1905-1910 MHz	1985-1990 MHz

FIG. 19 *PWAN Airlink RF Band/Subband Organization*

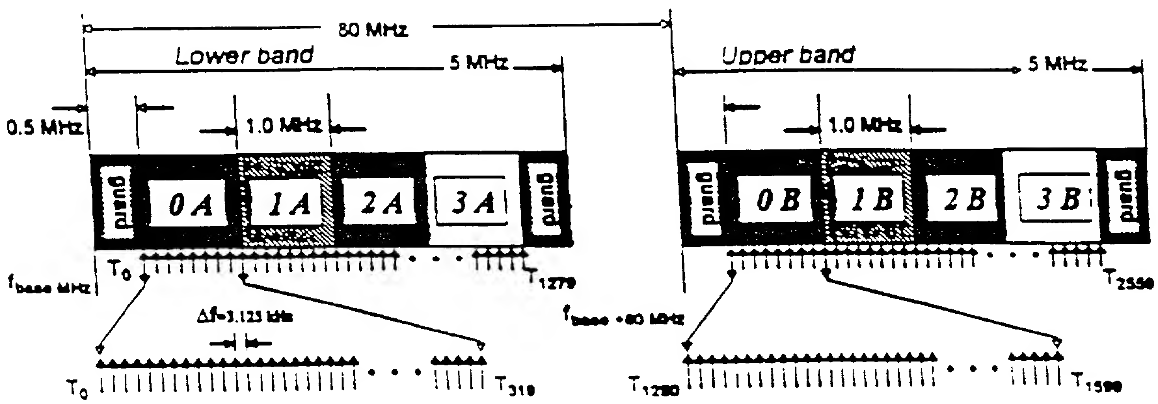


FIG. 20

Tones Within Each Subband

Subband pair designation		Tones
Subband pair 0	0 A	$\{T_0, T_1, \ldots T_{319}\}$
	0 B	$\{T_{1280}, T_{1281}, \ldots T_{1599}\}$
Subband pair 1	1 A	$\{T_{320}, T_{321}, \ldots T_{639}\}$
	1 B	$\{T_{1600}, T_{1601}, \ldots T_{1919}\}$
Subband pair 2	2 A	$\{T_{640}, T_{641}, \ldots T_{959}\}$
	2 B	$\{T_{1920}, T_{1921}, \ldots T_{2239}\}$
Subband pair 3	3 A	$\{T_{960}, T_{961}, \ldots T_{1279}\}$
	3 B	$\{T_{2240}, T_{2241}, \ldots T_{2559}\}$

FIG. 21 *Traffic Partitions*

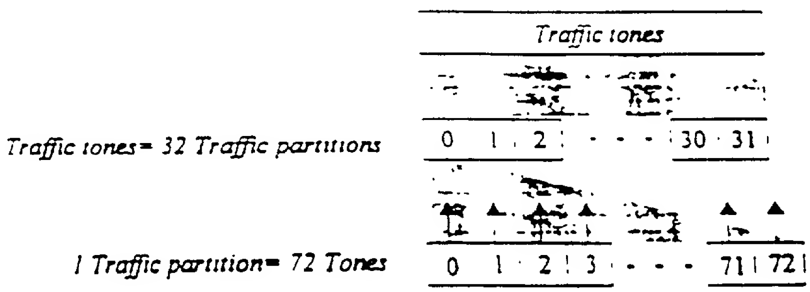


FIG. 22 *Tone Mapping to the ith Traffic Partition*

Tone Index	Tone	Tone Index	Tone	Tone Index	Tone	Tone Index	Tone
$P_i(0)$	T_{20i+1}	$P_i(18)$	$T_{20i+161}$	$P_i(36)$	$T_{20i+1281}$	$P_i(54)$	$T_{20i+1441}$
$P_i(1)$	T_{20i+2}	$P_i(19)$	$T_{20i+162}$	$P_i(37)$	$T_{20i+1282}$	$P_i(55)$	$T_{20i+1442}$
$P_i(2)$	T_{20i+3}	$P_i(20)$	$T_{20i+163}$	$P_i(38)$	$T_{20i+1283}$	$P_i(56)$	$T_{20i+1443}$
$P_i(3)$	T_{20i+4}	$P_i(21)$	$T_{20i+164}$	$P_i(39)$	$T_{20i+1284}$	$P_i(57)$	$T_{20i+1444}$
$P_i(4)$	T_{20i+5}	$P_i(22)$	$T_{20i+165}$	$P_i(40)$	$T_{20i+1285}$	$P_i(58)$	$T_{20i+1445}$
$P_i(5)$	T_{20i+6}	$P_i(23)$	$T_{20i+166}$	$P_i(41)$	$T_{20i+1286}$	$P_i(59)$	$T_{20i+1446}$
$P_i(6)$	T_{20i+7}	$P_i(24)$	$T_{20i+167}$	$P_i(42)$	$T_{20i+1287}$	$P_i(60)$	$T_{20i+1447}$
$P_i(7)$	T_{20i+8}	$P_i(25)$	$T_{20i+168}$	$P_i(43)$	$T_{20i+1288}$	$P_i(61)$	$T_{20i+1448}$
$P_i(8)$	T_{20i+9}	$P_i(26)$	$T_{20i+169}$	$P_i(44)$	$T_{20i+1289}$	$P_i(62)$	$T_{20i+1449}$
$P_i(9)$	T_{20i+11}	$P_i(27)$	$T_{20i+171}$	$P_i(45)$	$T_{20i+1291}$	$P_i(63)$	$T_{20i+1451}$
$P_i(10)$	T_{20i+12}	$P_i(28)$	$T_{20i+172}$	$P_i(46)$	$T_{20i+1292}$	$P_i(64)$	$T_{20i+1452}$
$P_i(11)$	T_{20i+13}	$P_i(29)$	$T_{20i+173}$	$P_i(47)$	$T_{20i+1293}$	$P_i(65)$	$T_{20i+1453}$
$P_i(12)$	T_{20i+14}	$P_i(30)$	$T_{20i+174}$	$P_i(48)$	$T_{20i+1294}$	$P_i(66)$	$T_{20i+1454}$
$P_i(13)$	T_{20i+15}	$P_i(31)$	$T_{20i+175}$	$P_i(49)$	$T_{20i+1295}$	$P_i(67)$	$T_{20i+1455}$
$P_i(14)$	T_{20i+16}	$P_i(32)$	$T_{20i+176}$	$P_i(50)$	$T_{20i+1296}$	$P_i(68)$	$T_{20i+1456}$
$P_i(15)$	T_{20i+17}	$P_i(33)$	$T_{20i+177}$	$P_i(51)$	$T_{20i+1297}$	$P_i(69)$	$T_{20i+1457}$
$P_i(16)$	T_{20i+18}	$P_i(34)$	$T_{20i+178}$	$P_i(52)$	$T_{20i+1298}$	$P_i(70)$	$T_{20i+1458}$
$P_i(17)$	T_{20i+19}	$P_i(35)$	$T_{20i+179}$	$P_i(53)$	$T_{20i+1299}$	$P_i(71)$	$T_{20i+1459}$

FIG. 23 *Overhead Tone Mapping to Channels for the ith Subband Pair*

Tones allocated to CLC/CAC in subband pair i ($CLC/CAC_{i,0}$)							
index	*tone*	*index*	*tone*	*index*	*tone*	*index*	*tone*
0	T_{320i}	1	$T_{320i+20}$	2	$T_{320i+40}$	3	$T_{320i+60}$
4	$T_{320i+160}$	5	$T_{320i+180}$	6	$T_{320i+200}$	7	$T_{320i+220}$
8	$T_{320i+1280}$	9	$T_{320i+1300}$	10	$T_{320i+1320}$	11	$T_{320i+1340}$
12	$T_{320i+1440}$	13	$T_{320i+1460}$	14	$T_{320i+1480}$	15	$T_{320i+1500}$
Tones allocated to BRC/CAC in subband pair i ($BRC_i/CAC_{i,1}$)							
index	*tone*	*index*	*tone*	*index*	*tone*	*index*	*tone*
0	$T_{320i+90}$	1	$T_{320i+110}$	2	$T_{320i+130}$	3	$T_{320i+150}$
4	$T_{320i+250}$	5	$T_{320i+270}$	6	$T_{320i+290}$	7	$T_{320i+310}$
8	$T_{320i+1370}$	9	$T_{320i+1390}$	10	$T_{320i+1410}$	11	$T_{320i+1430}$
12	$T_{320i+1530}$	13	$T_{320i+1550}$	14	$T_{320i+1570}$	15	$T_{320i+1590}$
Tones allocated to RSC/DCC in subband pair i (RSC_i/DCC_i)							
index	*tone*	*index*	*tone*	*index*	*tone*	*index*	*tone*
0	$T_{320i+10}$	1	$T_{320i+30}$	2	$T_{320i+50}$	3	$T_{320i+70}$
4	$T_{320i+80}$	5	$T_{320i+100}$	6	$T_{320i+120}$	7	$T_{320i+140}$
8	$T_{320i+170}$	9	$T_{320i+190}$	10	$T_{320i+210}$	11	$T_{320i+230}$
12	$T_{320i+240}$	13	$T_{320i+260}$	14	$T_{320i+280}$	15	$T_{320i+300}$
16	$T_{320i+1290}$	17	$T_{320i+1310}$	18	$T_{320i+1330}$	19	$T_{320i+1350}$
20	$T_{320i+1360}$	21	$T_{320i+1380}$	22	$T_{320i+1400}$	23	$T_{320i+1420}$
24	$T_{320i+1450}$	25	$T_{320i+1470}$	26	$T_{320i+1490}$	27	$T_{320i+1510}$
28	$T_{320i+1520}$	29	$T_{320i+1540}$	30	$T_{320i+1560}$	31	$T_{320i+1580}$

FIG. 24 *Division of Tone Space to Traffic and Overhead Tones*

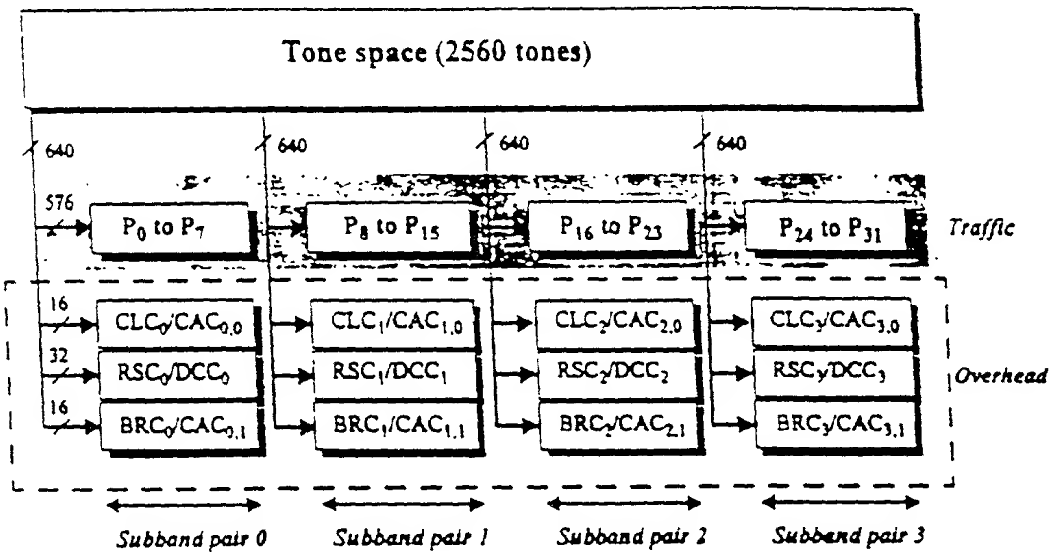


FIG. 25 *Time Division Duplex for Base and RU Transmissions*

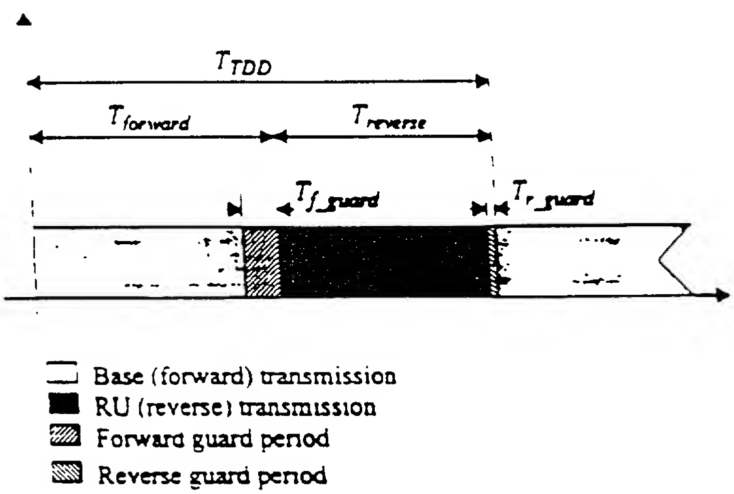


FIG. 26 *Details of Forward and Reverse Channel Time Parameters*

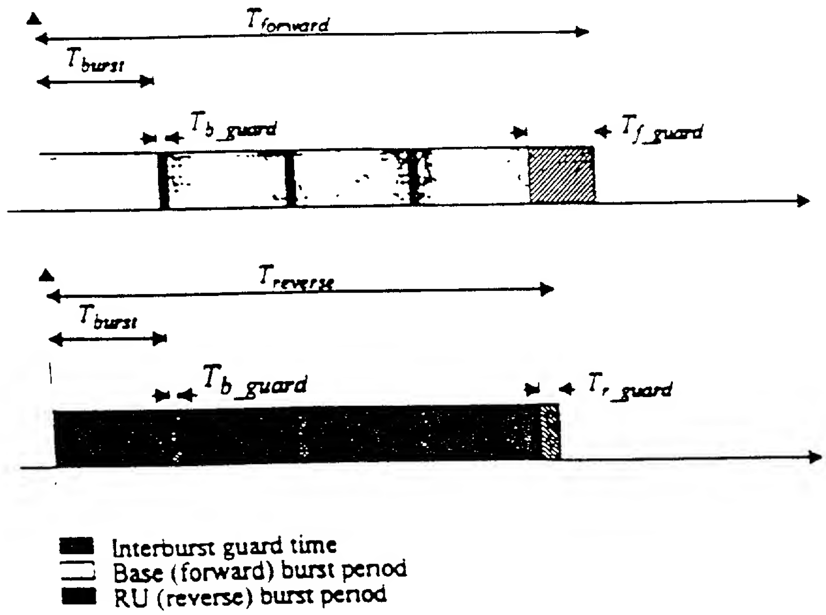


FIG. 27 *TDD Parameter Values*

TDD parameter	Value (μs)
$T_{forward}$	1610
$T_{reverse}$	1390
T_{f_guard}	255
T_{r_guard}	35
$T_{revisit}$	3000
T_{burst}	320
T_{b_guard}	25

FIG. 28 Physical Layer Framing Structure

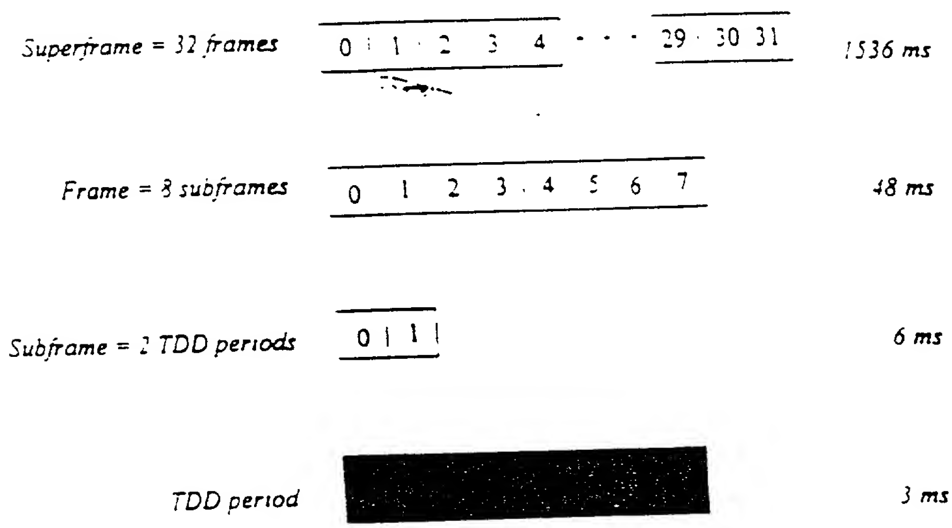


FIG. 29 Phase A Subband Pair Assignment within a Cell

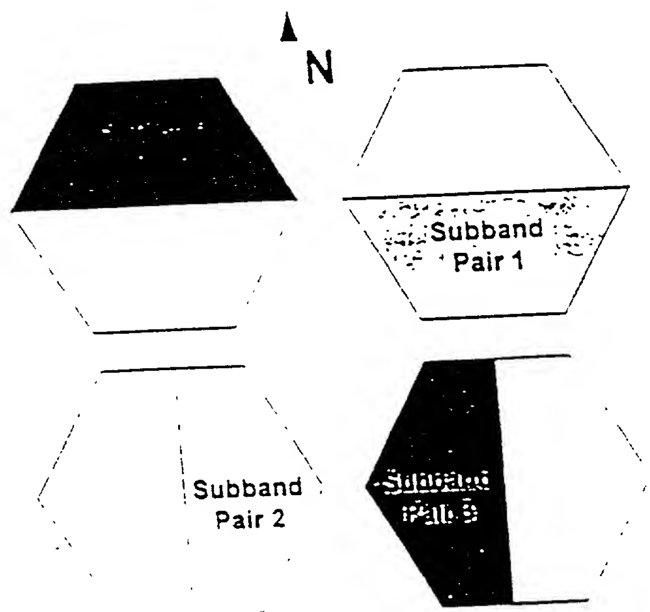


FIG. 30 *Phase-A Subband Pair Assignment across Cells*

North-South Facing Sectors

East-West Facing Sectors

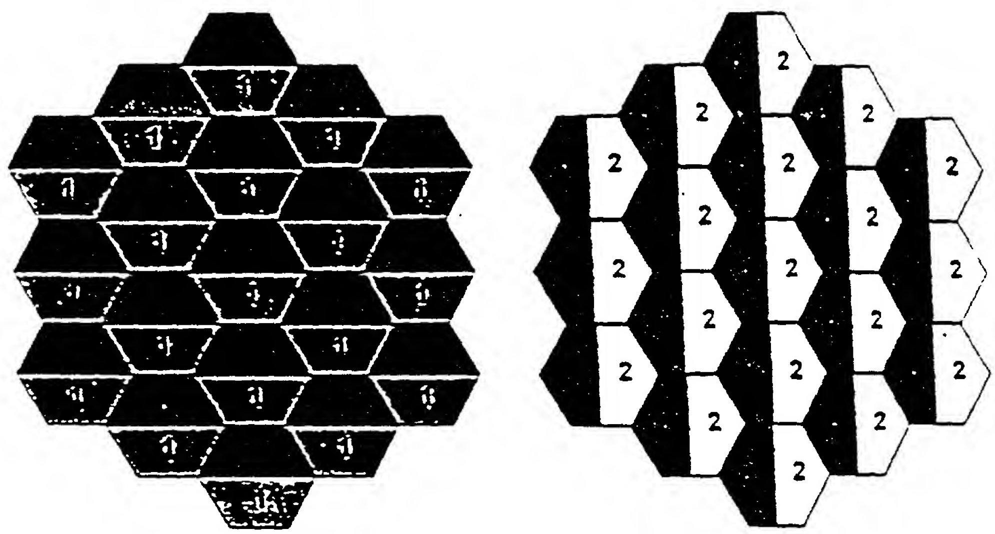


FIG. 31 Functional Block Diagram - Upper Physical Layer of Base Transmitter for High Capacity Mode

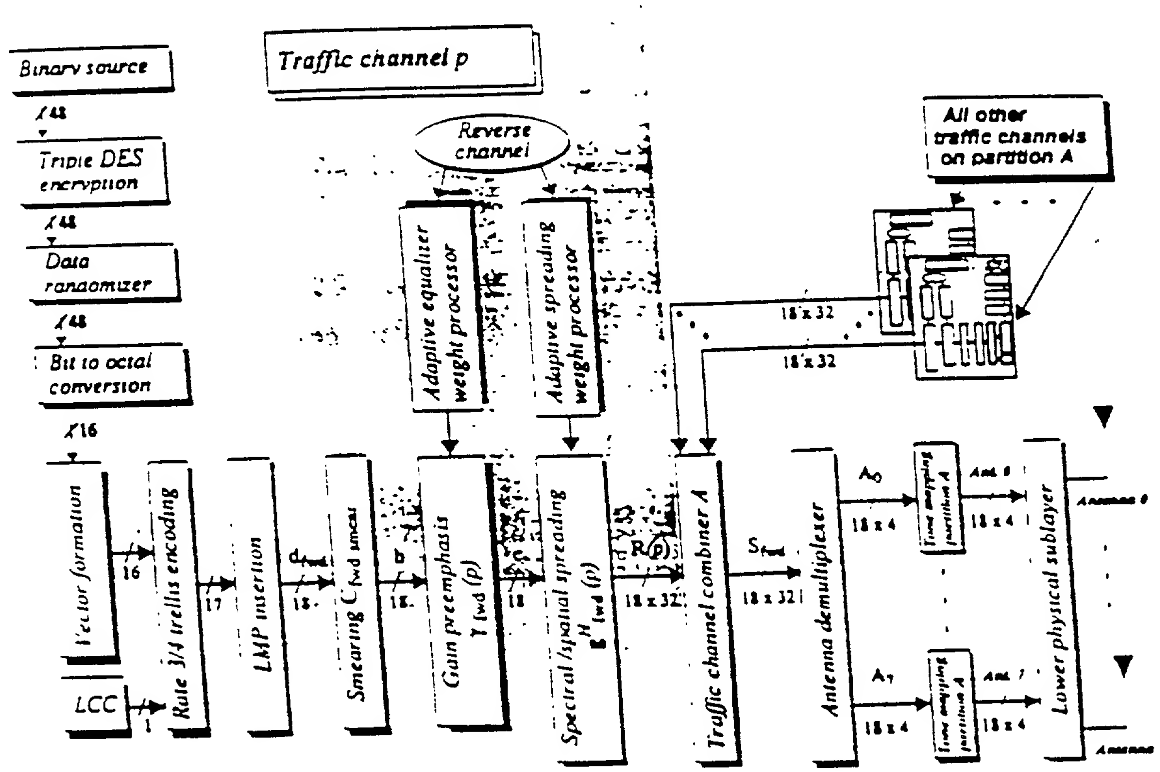


FIG. 32 Data Transformation Diagram - High Capacity Forward Channel Transmissions

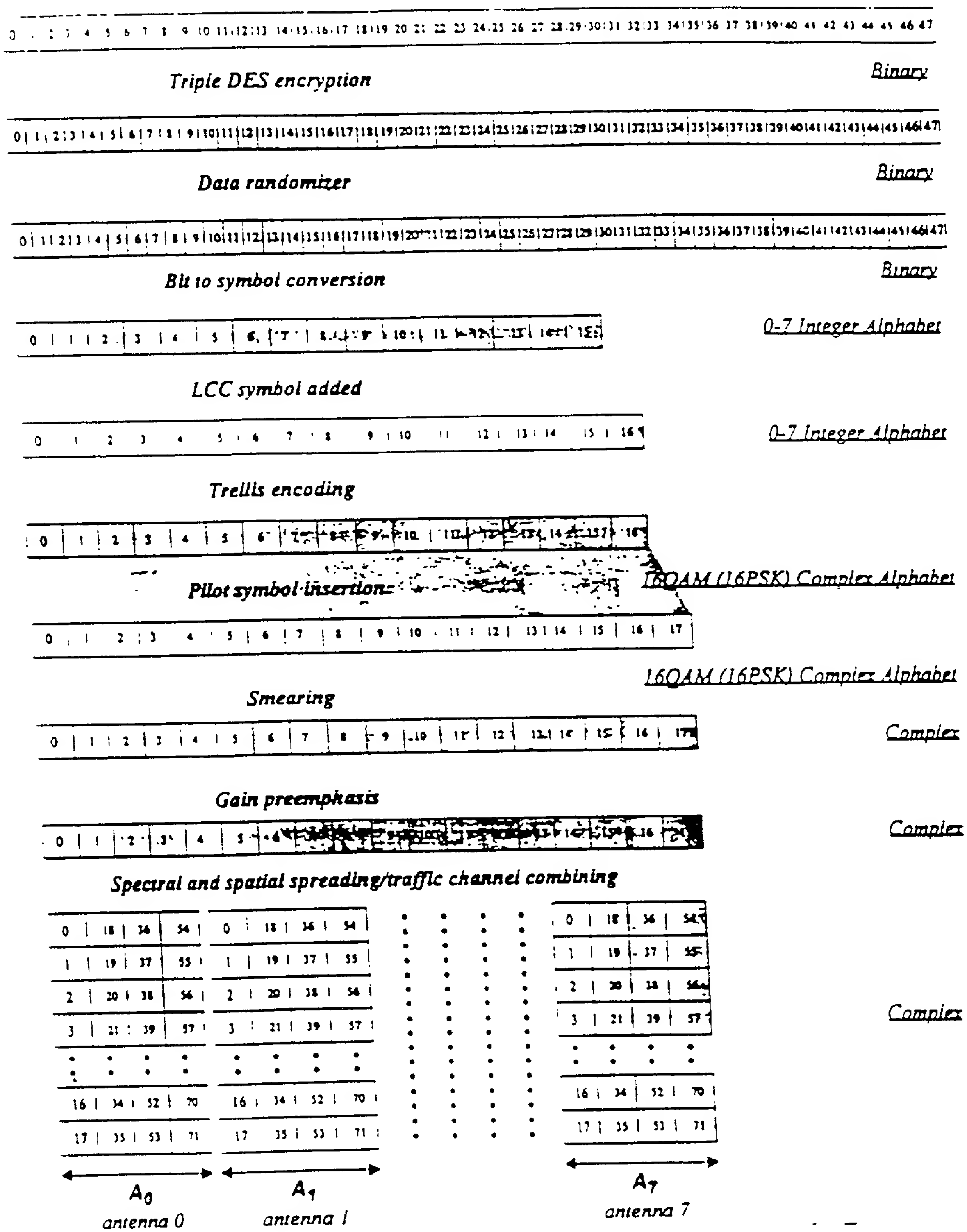


FIG. 33 Functional Block Diagram - Upper Physical Layer of Base Transmitter for Medium Capacity Mode

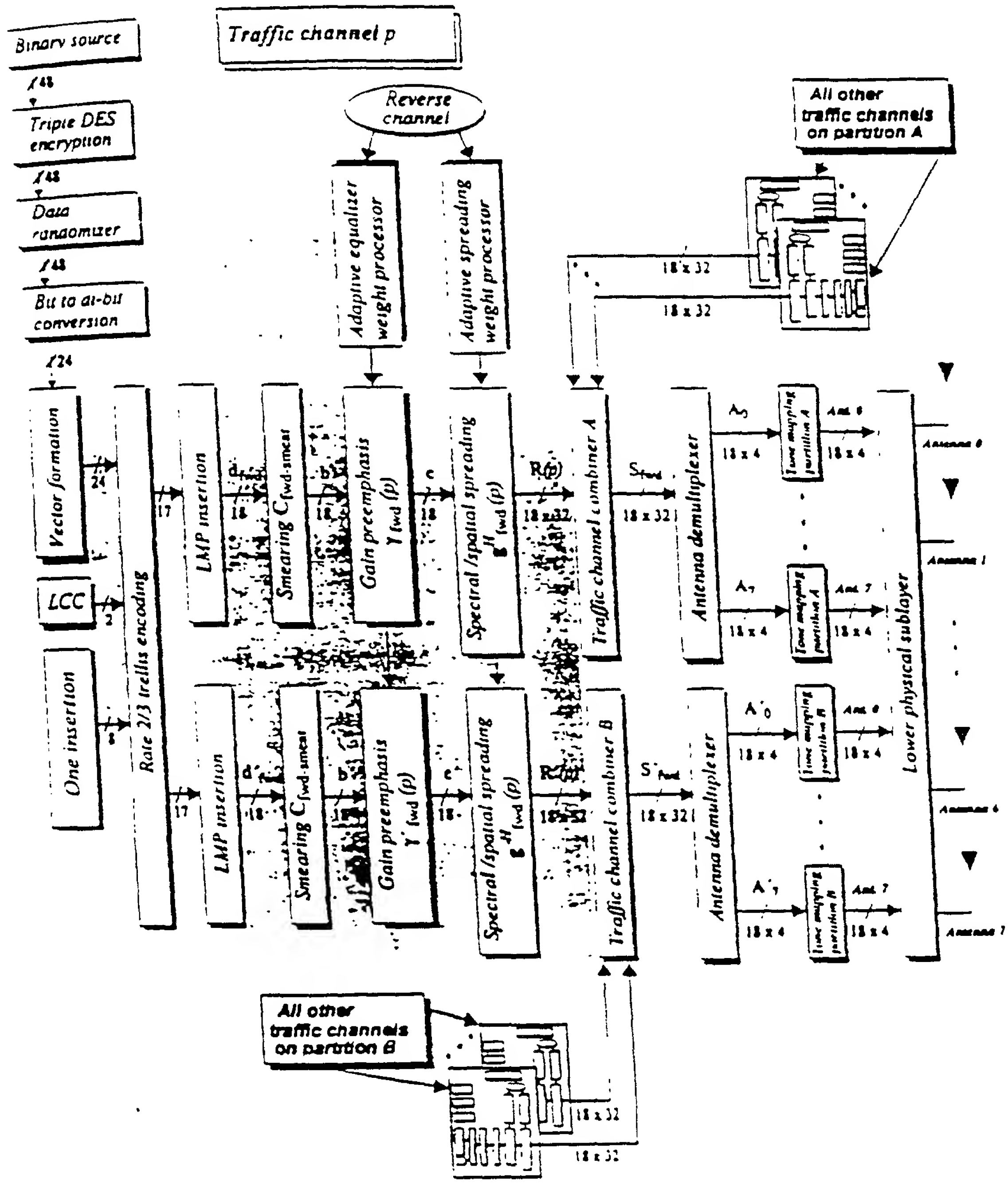


FIG. 34

Data Transformation Diagram - Medium Capacity Forward Channel Transmissions

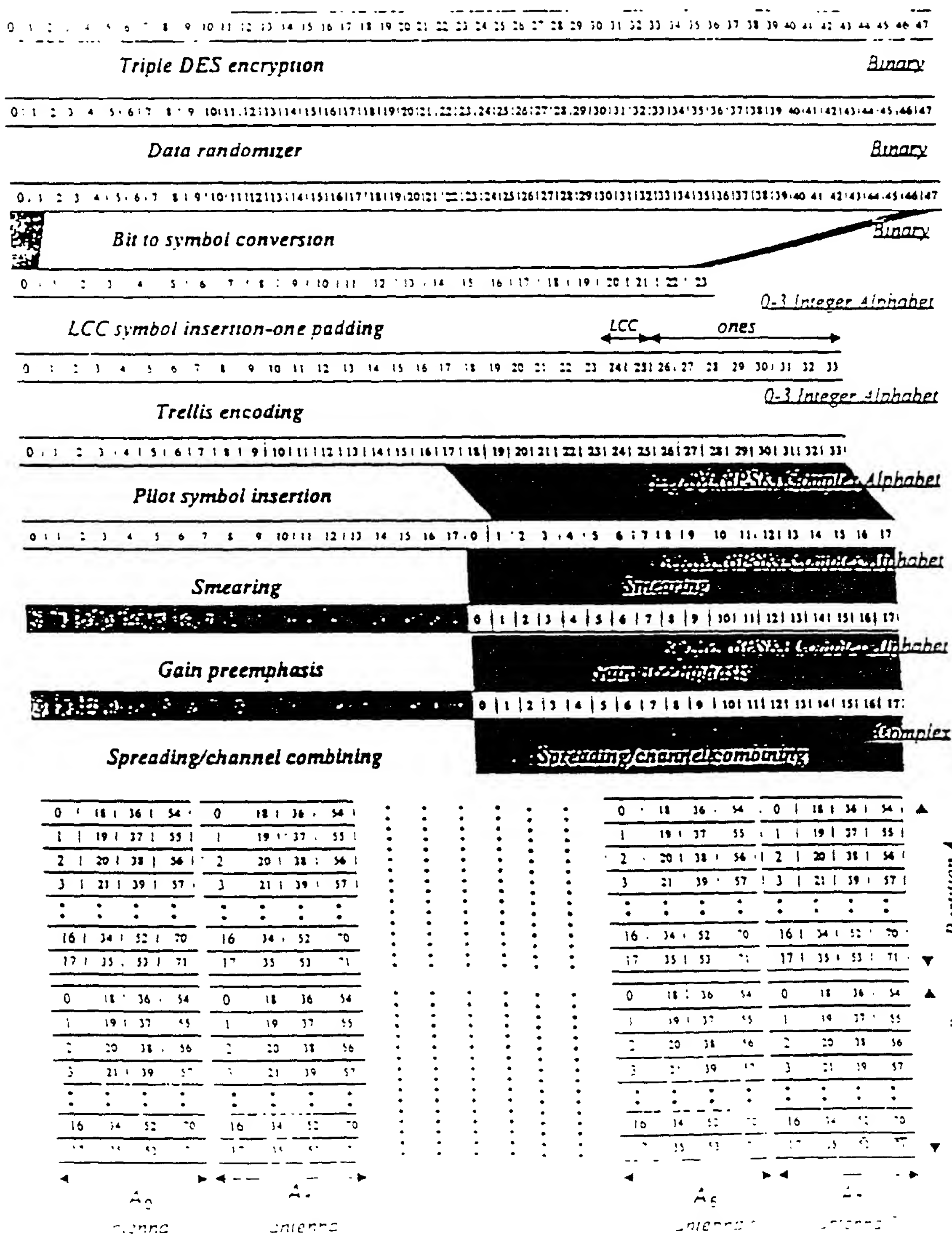


FIG. 35 Functional Block Diagram - Upper Physical Layer of Base Transmitter for Low Capacity Mode

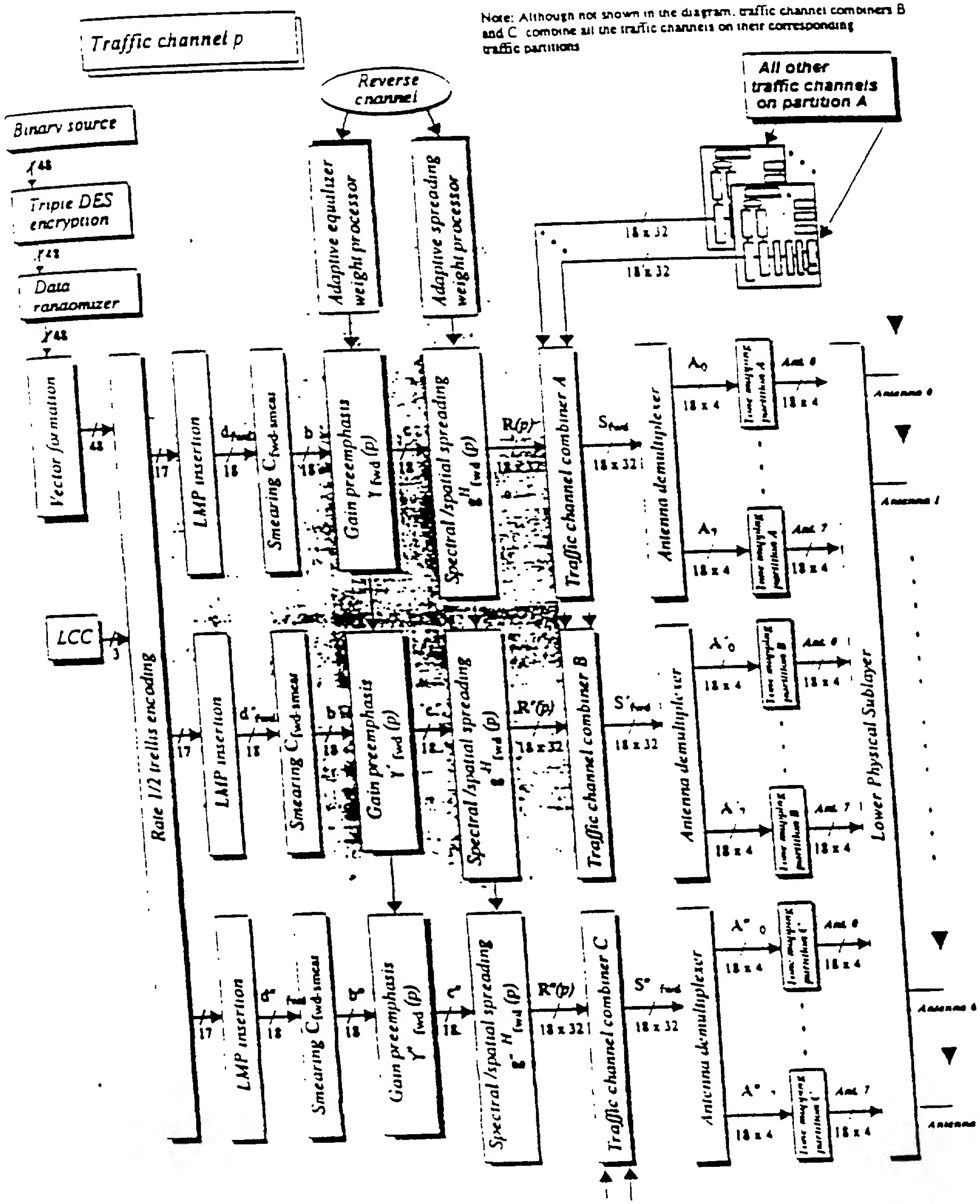


FIG. 36 Data Transformation Diagram - Low Capacity Forward Channel Transmissions

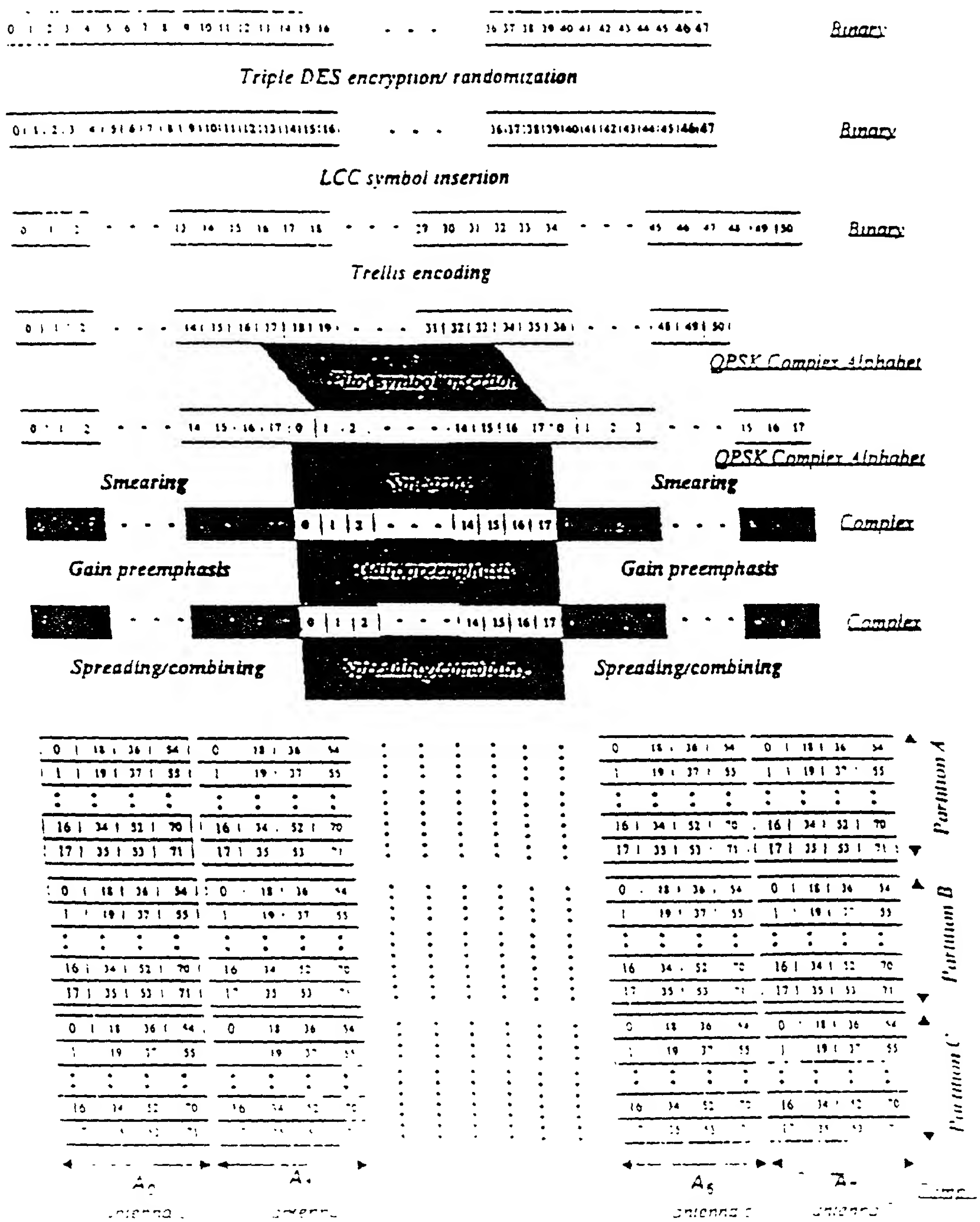


FIG. 37 Triple DES Encryption Algorithm

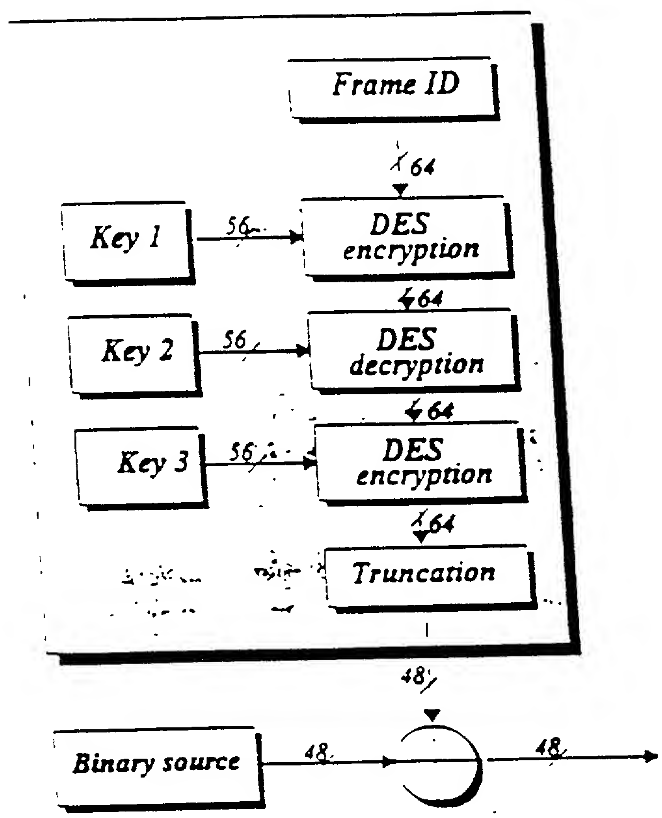


FIG. 38 *Feed Forward Shift Register Implementation of Rate 3/4, 16PSK Trellis Encoder for High Capacity Mode*

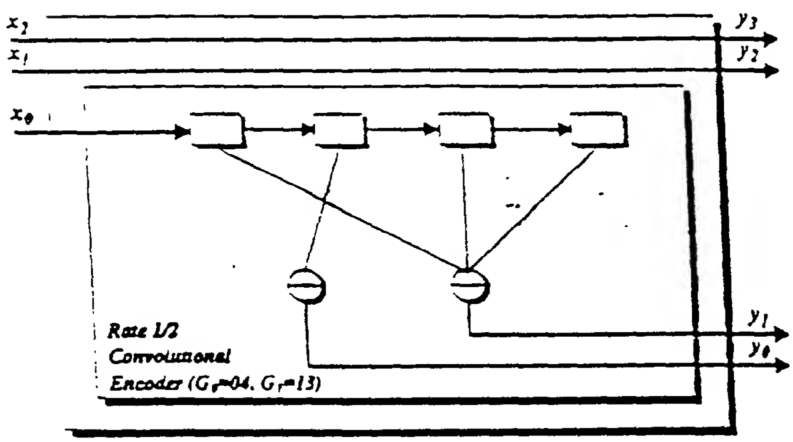


FIG. 39 *Feed Forward Shift Register Implementation of Rate 3/4, 16QAM Trellis Encoder for High Capacity Mode*

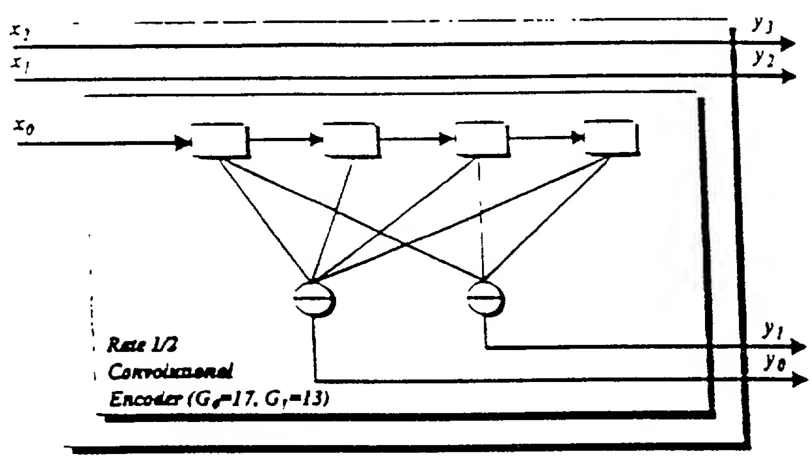


FIG. 40 *Signal Mappings for Rate 3/4, 16QAM and 16PSK Trellis Encoding Schemes Employed in High Capacity Mode*

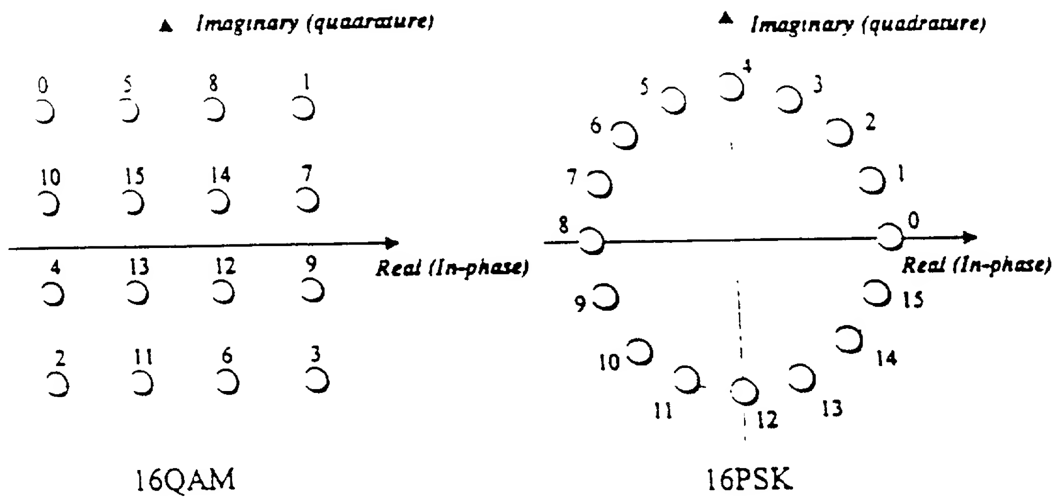


FIG. 41

Signal Mappings for Rate 3/4, Pragmatic16QAM and 16PSK Trellis Encoding Schemes Employed in High Capacity Mode

Output symbol	Output bits				Signal mapping (16QAM)		Signal mapping (16PSK)	
	y_3	y_2	y_1	y_0	In phase	Quadrature	In phase	Quadrature
0	0	0	0	0	$-3/\sqrt{10}$	$3/\sqrt{10}$	1.0	0.0
1	0	0	0	1	$3/\sqrt{10}$	$3/\sqrt{10}$	0.924	0.383
2	0	0	1	0	$-3/\sqrt{10}$	$-3/\sqrt{10}$	0.707	0.707
3	0	0	1	1	$3/\sqrt{10}$	$-3/\sqrt{10}$	0.383	0.924
4	0	1	0	0	$-3/\sqrt{10}$	$-1/\sqrt{10}$	0	1
5	0	1	0	1	$-1/\sqrt{10}$	$3/\sqrt{10}$	-0.383	0.924
6	0	1	1	0	$1/\sqrt{10}$	$-3/\sqrt{10}$	-0.707	0.707
7	0	1	1	1	$3/\sqrt{10}$	$1/\sqrt{10}$	-0.924	0.383
8	1	0	0	0	$1/\sqrt{10}$	$3/\sqrt{10}$	-1.0	0.0
9	1	0	0	1	$3/\sqrt{10}$	$-1/\sqrt{10}$	-0.924	-0.383
10	1	0	1	0	$-3/\sqrt{10}$	$1/\sqrt{10}$	-0.707	-0.707
11	1	0	1	1	$-1/\sqrt{10}$	$-3/\sqrt{10}$	-0.383	-0.924
12	1	1	0	0	$1/\sqrt{10}$	$-1/\sqrt{10}$	0	-1
13	1	1	0	1	$-1/\sqrt{10}$	$-1/\sqrt{10}$	0.383	-0.924
14	1	1	1	0	$1/\sqrt{10}$	$1/\sqrt{10}$	0.707	-0.707
15	1	1	1	1	$-1/\sqrt{10}$	$1/\sqrt{10}$	0.924	-0.383

FIG. 42 *Feed Forward Shift Register Implementation of Rate 2/3, 8PSK Trellis Encoder for Medium Capacity Mode*

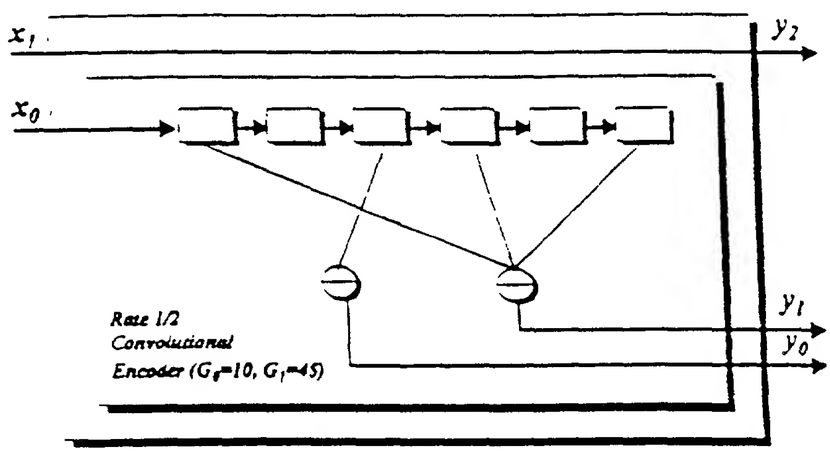


FIG. 43 *Feed Forward Shift Register Implementation of Rate 2/3, 8QAM Trellis Encoder for Medium Capacity Mode*

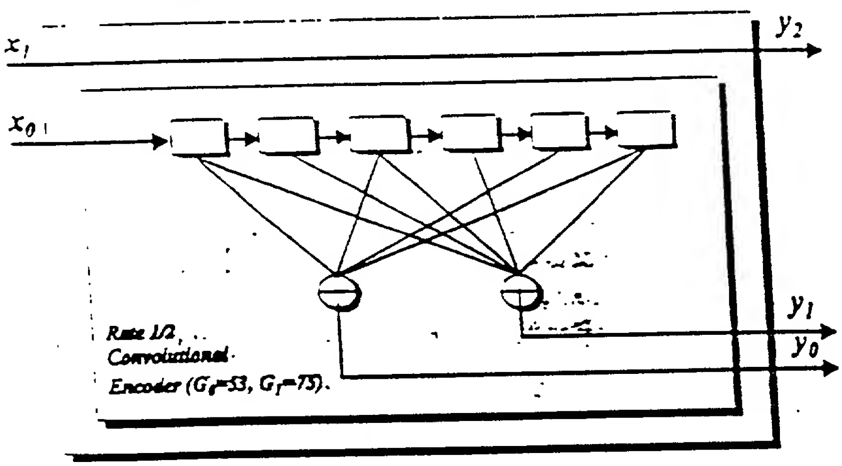


FIG. 44 Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode

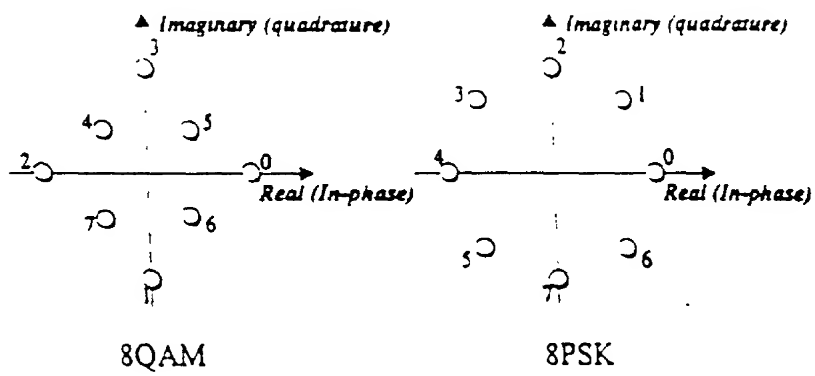


FIG. 45 *Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode*

Output symbol	Output bits			Signal mapping (8QAM)		Signal mapping (8PSK)	
	y_2	y_1	y_0	In phase	Quadrature	In phase	Quadrature
0	0	0	0	1.21	0	1	0
1	0	0	1	0	-1.21	$1/\sqrt{2}$	$1/\sqrt{2}$
2	0	1	0	-1.21	0	0	1
3	0	1	1	0	1.21	$-1/\sqrt{2}$	$1/\sqrt{2}$
4	1	0	0	-0.518	0.518	-1	0
5	1	0	1	0.518	0.518	$-1/\sqrt{2}$	$-1/\sqrt{2}$
6	1	1	0	0.518	-0.518	0	-1
7	1	1	1	-0.518	-0.518	$1/\sqrt{2}$	$-1/\sqrt{2}$

FIG. 46 Feed Forward Shift Register Implementation of Rate 1/2 Convolutional Encoder for Low Capacity Mode

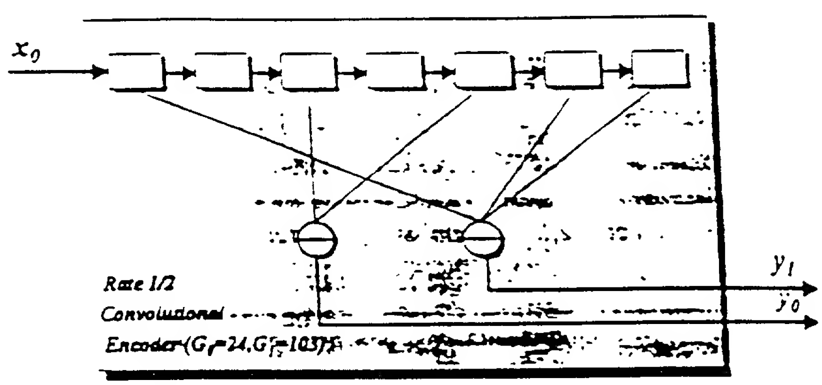


FIG. 47 Signal Mapping for Rate 1/2, QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode

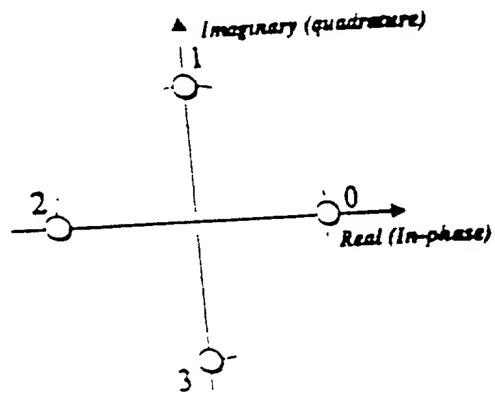


FIG. 48 *Gray-Coded Mapping for Rate 1/2. QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode*

Output symbol	Output bits		Signal mapping	
	y_1	y_0	In phase	Quadrature
0	0	0	1	0
1	0	1	0	1
2	1	0	-1	0
3	1	1	0	-1

FIG. 49 *Base Mapping of Elements of Received Weight Vector to Antenna Elements and Tones*

$w_0 \longrightarrow$ *(antenna element 0, tone 0)*
$w_1 \longrightarrow$ *(antenna element 0, tone 1)*
$w_2 \longrightarrow$ *(antenna element 0, tone 2)*
$w_3 \longrightarrow$ *(antenna element 0, tone 3)*
$w_4 \longrightarrow$ *(antenna element 1, tone 0)*
$w_5 \longrightarrow$ *(antenna element 1, tone 1)*
$w_6 \longrightarrow$ *(antenna element 1, tone 2)*
$w_7 \longrightarrow$ *(antenna element 1, tone 3)*

.
.
.
.

$w_{28} \longrightarrow$ *(antenna element 7, tone 0)*
$w_{29} \longrightarrow$ *(antenna element 7, tone 1)*
$w_{30} \longrightarrow$ *(antenna element 7, tone 2)*
$w_{31} \longrightarrow$ *(antenna element 7, tone 3)*

FIG. 50 Block Diagram Representation of CLC Physical Layer Format

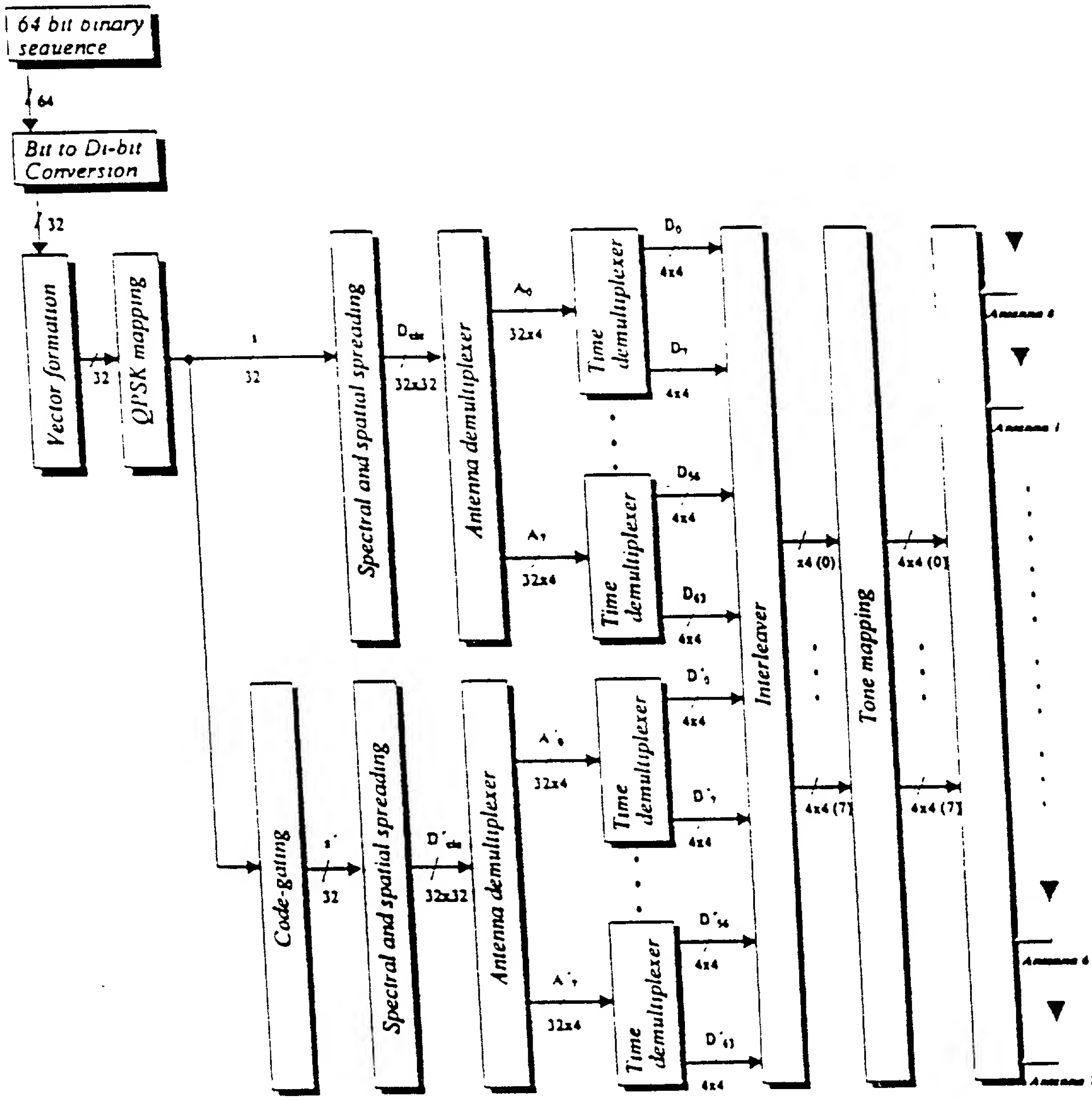


FIG. 51 QPSK Signal Mapping for the CLC Channel

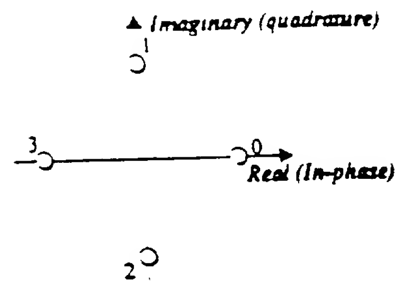


FIG. 51' *QPSK Signal Mapping for the CLC Channel*

Symbol	Signal mapping	
	In phase	Quadrature
0	1	0
1	0	1
2	0	-1
3	-1	0

FIG. 52

The CLC Interleaving Rule

Antenna	Burst number															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_7	D'_6	D'_5	D_4	D'_3	D_2	D_1	D'_0
1	D_8	D_9	D_{10}	D_{11}	D_{12}	D_{13}	D_{14}	D_{15}	D_{15}	D'_{14}	D'_{13}	D'_{12}	D'_{11}	D'_{10}	D_9	D_8
2	D_{16}	D_{17}	D_{18}	D_{19}	D_{20}	D_{21}	D_{22}	D_{23}	D'_{23}	D'_{22}	D_{21}	D'_{20}	D'_{19}	D'_{18}	D_{17}	D_{16}
3	D_{24}	D_{25}	D_{26}	D_{27}	D_{28}	D_{29}	D_{30}	D_{31}	D'_{31}	D'_{30}	D'_{29}	D'_{28}	D'_{27}	D'_{26}	D_{25}	D'_{24}
4	D_{32}	D_{33}	D_{34}	D_{35}	D_{36}	D_{37}	D_{38}	D_{39}	D'_{39}	D'_{38}	D'_{37}	D'_{36}	D'_{35}	D'_{34}	D'_{33}	D'_{32}
5	D_{40}	D_{41}	D_{42}	D_{43}	D_{44}	D_{45}	D_{46}	D_{47}	D'_{47}	D'_{46}	D'_{45}	D'_{44}	D'_{43}	D'_{42}	D'_{41}	D'_{40}
6	D_{48}	D_{49}	D_{50}	D_{51}	D_{52}	D_{53}	D_{54}	D_{55}	D'_{55}	D'_{54}	D'_{53}	D'_{52}	D'_{51}	D'_{50}	D'_{49}	D'_{48}
7	D_{56}	D_{57}	D_{58}	D_{59}	D_{60}	D_{61}	D_{62}	D_{63}	D_{63}	D'_{62}	D'_{61}	D'_{60}	D'_{59}	D'_{58}	D'_{57}	D'_{56}

FIG. 53 *Tone Mapping of (4 x 4) Interleaved Matrix Elements*

		Column number			
		0	**1**	**2**	**3**
Row number	*0*	$CLC_i(0)$[a]	$CLC_i(4)$	$CLC_i(8)$	$CLC_i(12)$
	1	$CLC_i(1)$	$CLC_i(5)$	$CLC_i(9)$	$CLC_i(13)$
	2	$CLC_i(2)$	$CLC_i(6)$	$CLC_i(10)$	$CLC_i(14)$
	3	$CLC_i(3)$	$CLC_i(7)$	$CLC_i(11)$	$CLC_i(15)$

a. i is the subband pair index (0, 1, 2, or 3).

FIG. 54 *Block Diagram representation of BRC Physical layer format.*

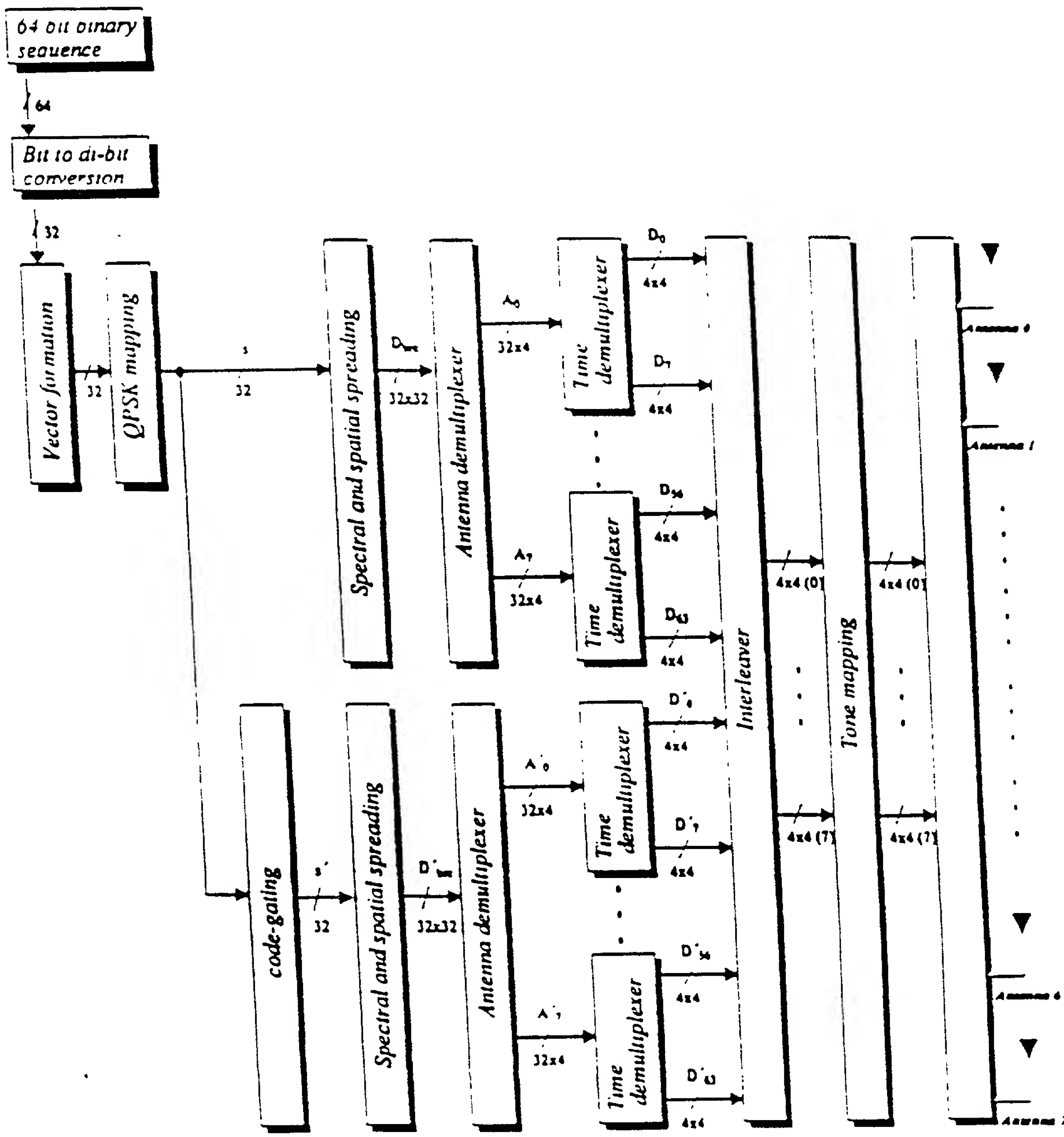
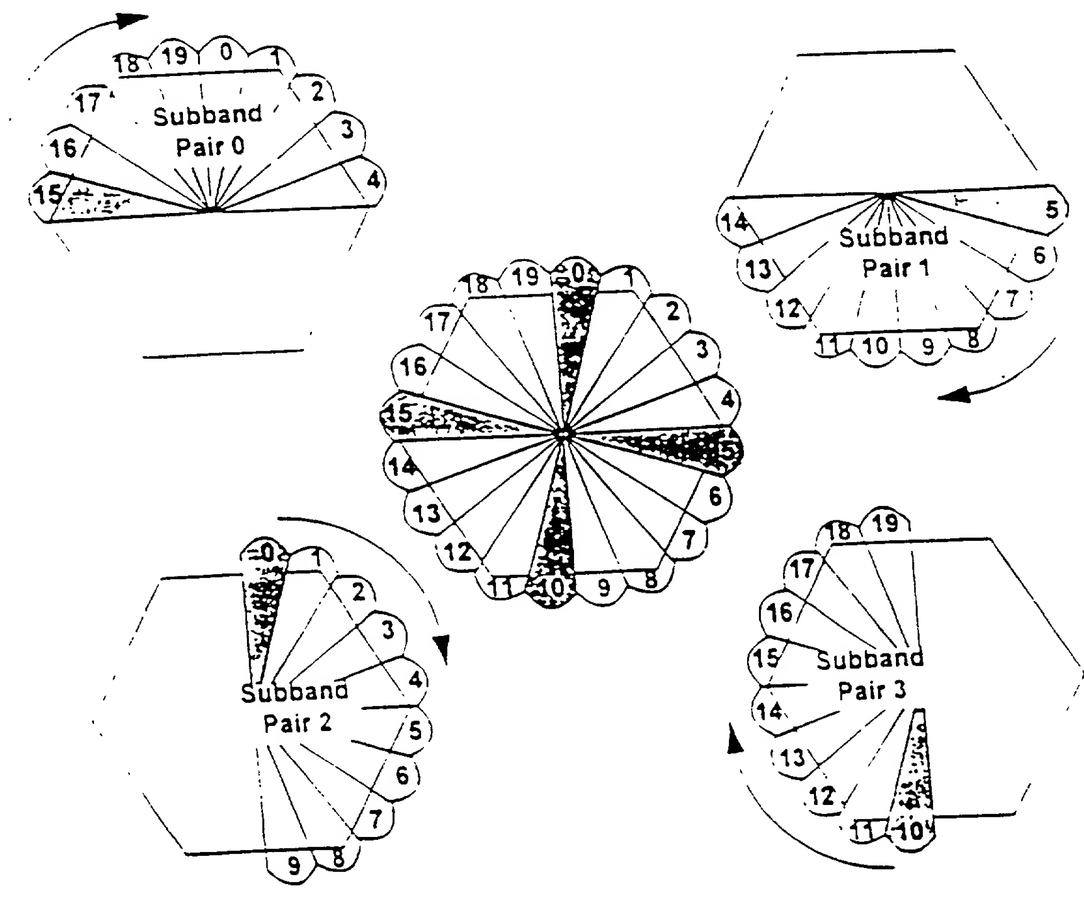


FIG. 55 *Tone Mapping the (4x 4) Interleaved Matrix Elements*

		Column number			
		0	*1*	*2*	*3*
Row number	*0*	$BRC_i(0)$[a]	$BRC_i(4)$	$BRC_i(8)$	$BRC_i(12)$
	1	$BRC_i(1)$	$BRC_i(5)$	$BRC_i(9)$	$BRC_i(13)$
	2	$BRC_i(2)$	$BRC_i(6)$	$BRC_i(10)$	$BRC_i(14)$
	3	$BRC_i(3)$	$BRC_i(7)$	$BRC_i(11)$	$BRC_i(15)$

a. i is the subband pair index (0, 1, 2, or 3). For the broadcast channel all the subband pairs will be active at the same time.

FIG. 56 Broadcast Channel Beam Sweep



	Beam sweeping order									
0	15	16	17	18	19	0	1	2	3	4
1	5	6	7	8	9	10	11	12	13	14
2	0	1	2	3	4	5	6	7	8	9
3	10	11	12	13	13	14	15	16	17	18

FIG. 57 *Functional Block Diagram - Upper Physical Layer of RU Transmitter for High Capacity Mode*

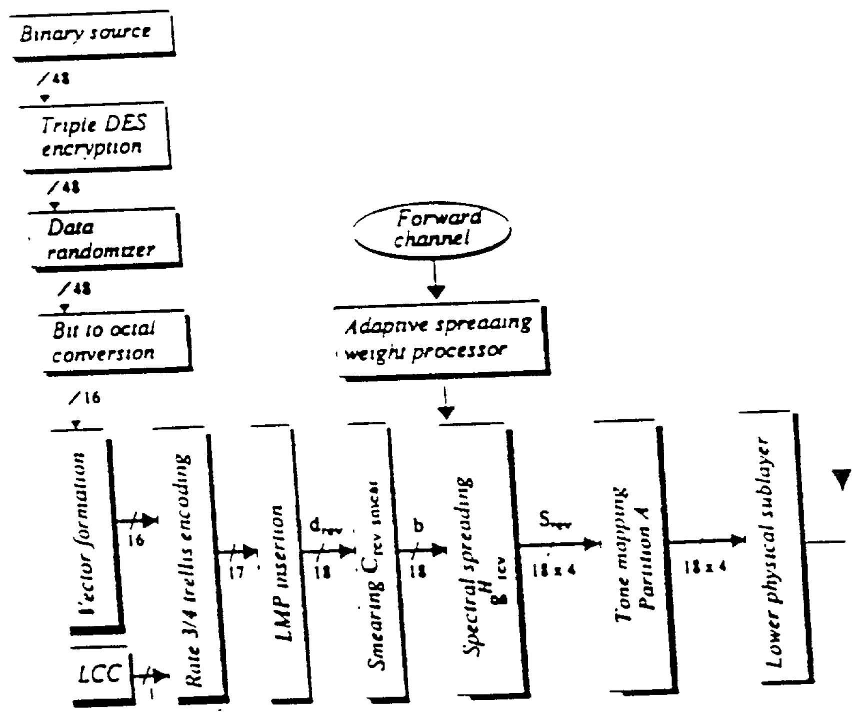


FIG. 58 Data Transformation Diagram - High Capacity Reverse Channel Transmissions

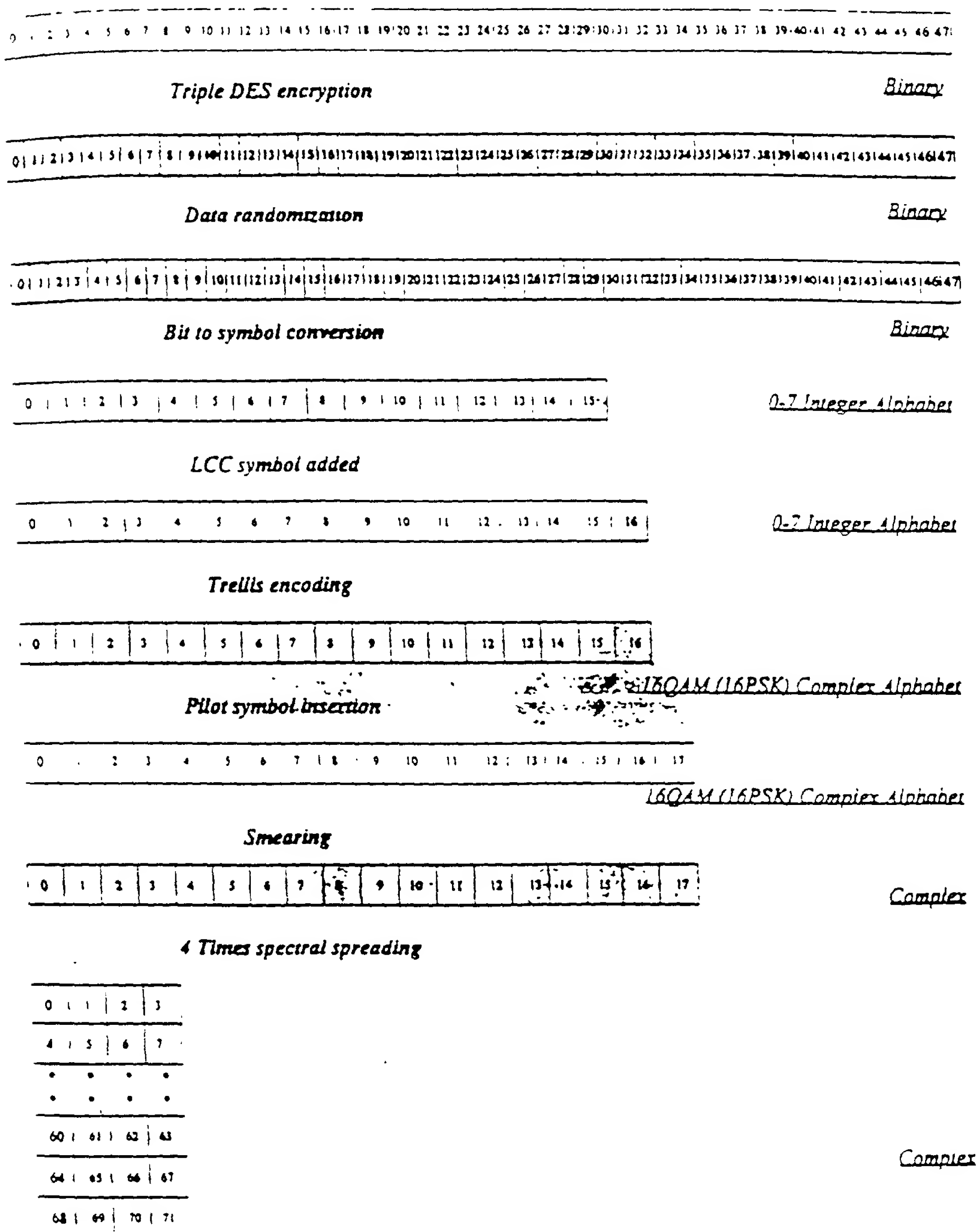


FIG. 59 *Functional Block Diagram - Upper Physical Layer of RU Transmitter for Medium Capacity Mode*

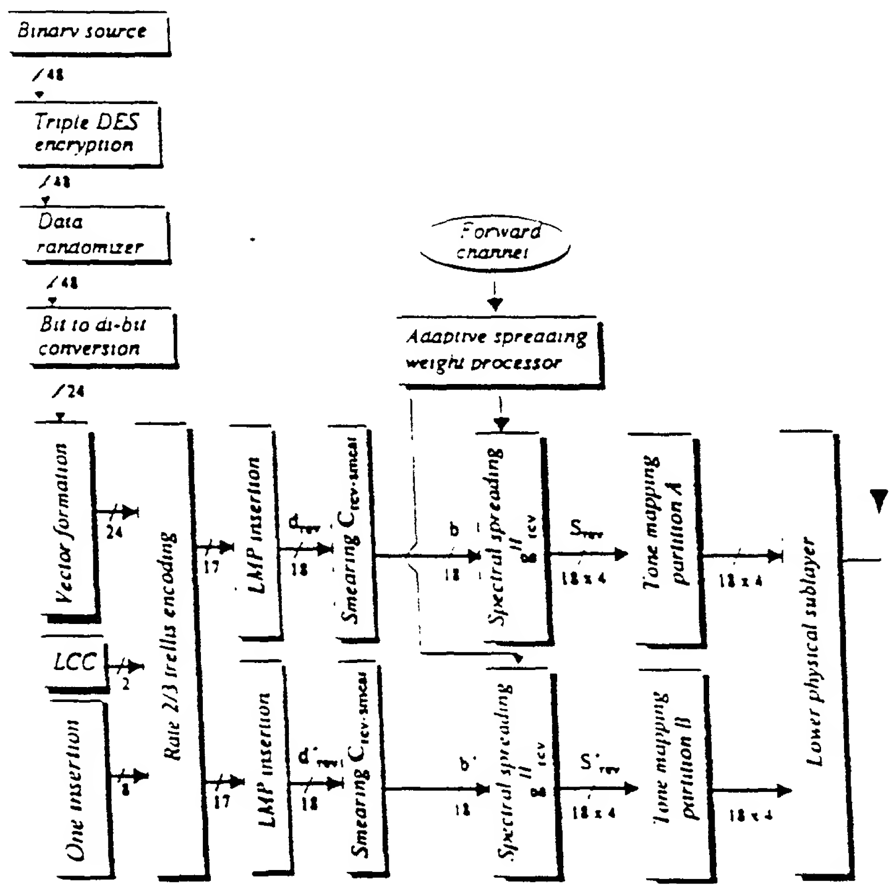


FIG. 60

Data Transformation Diagram - Medium Capacity Reverse Channel Transmissions

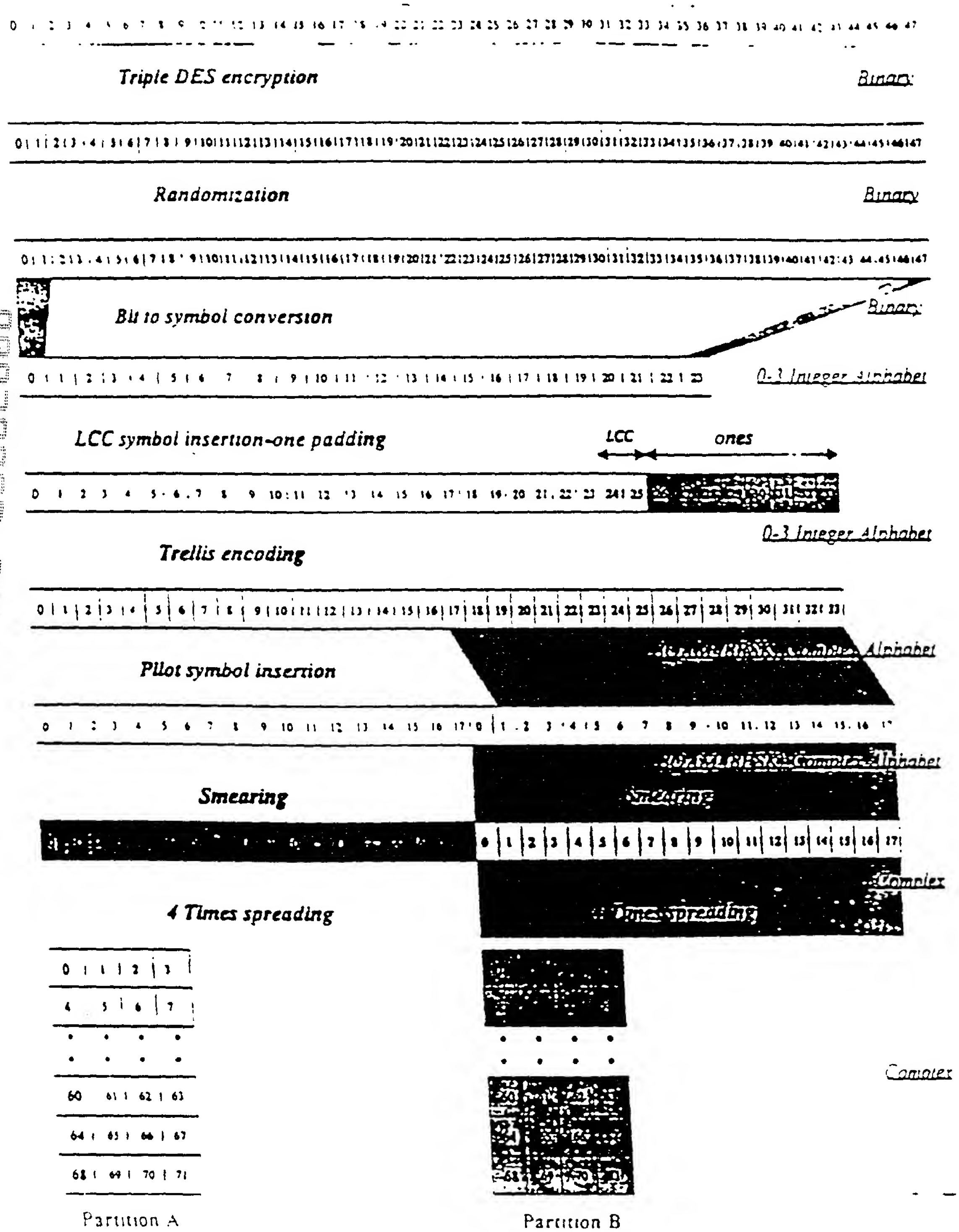


FIG. 61 *Functional Block Diagram - Upper Physical Layer of RU Transmitter for Low Capacity Mode*

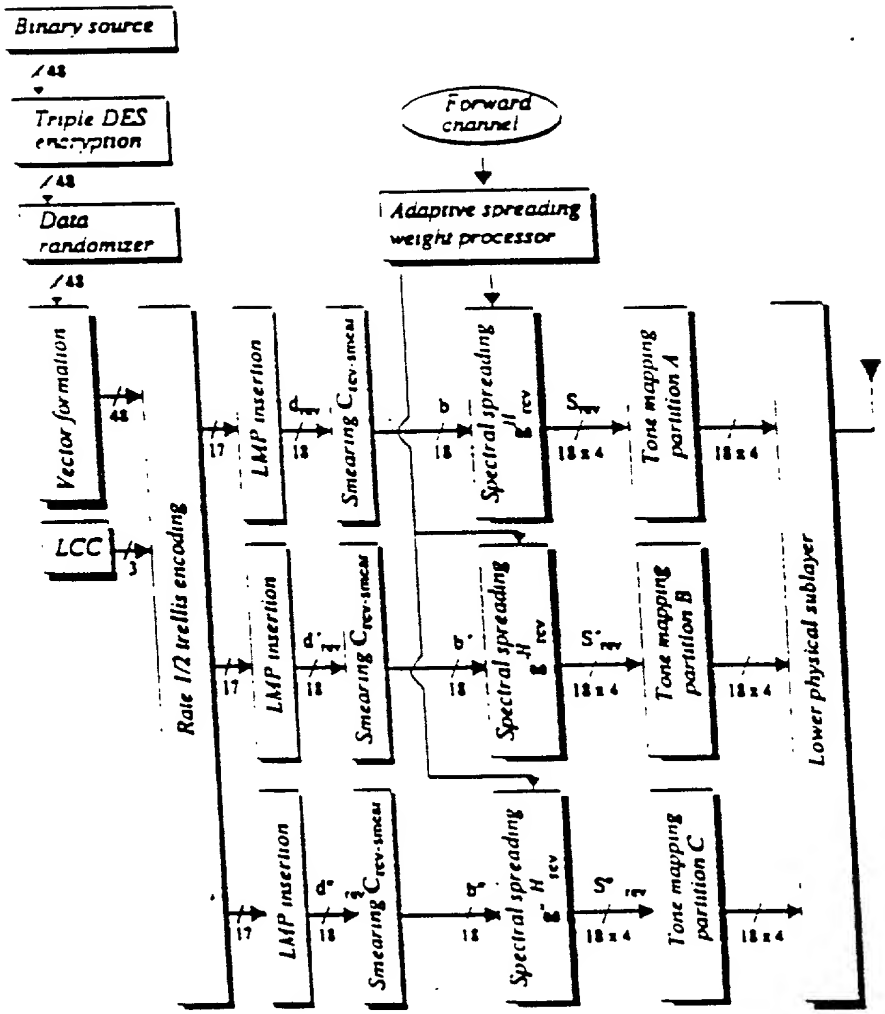


FIG. 62 Data Transformation Diagram - Low Capacity Reverse Channel Transmissions

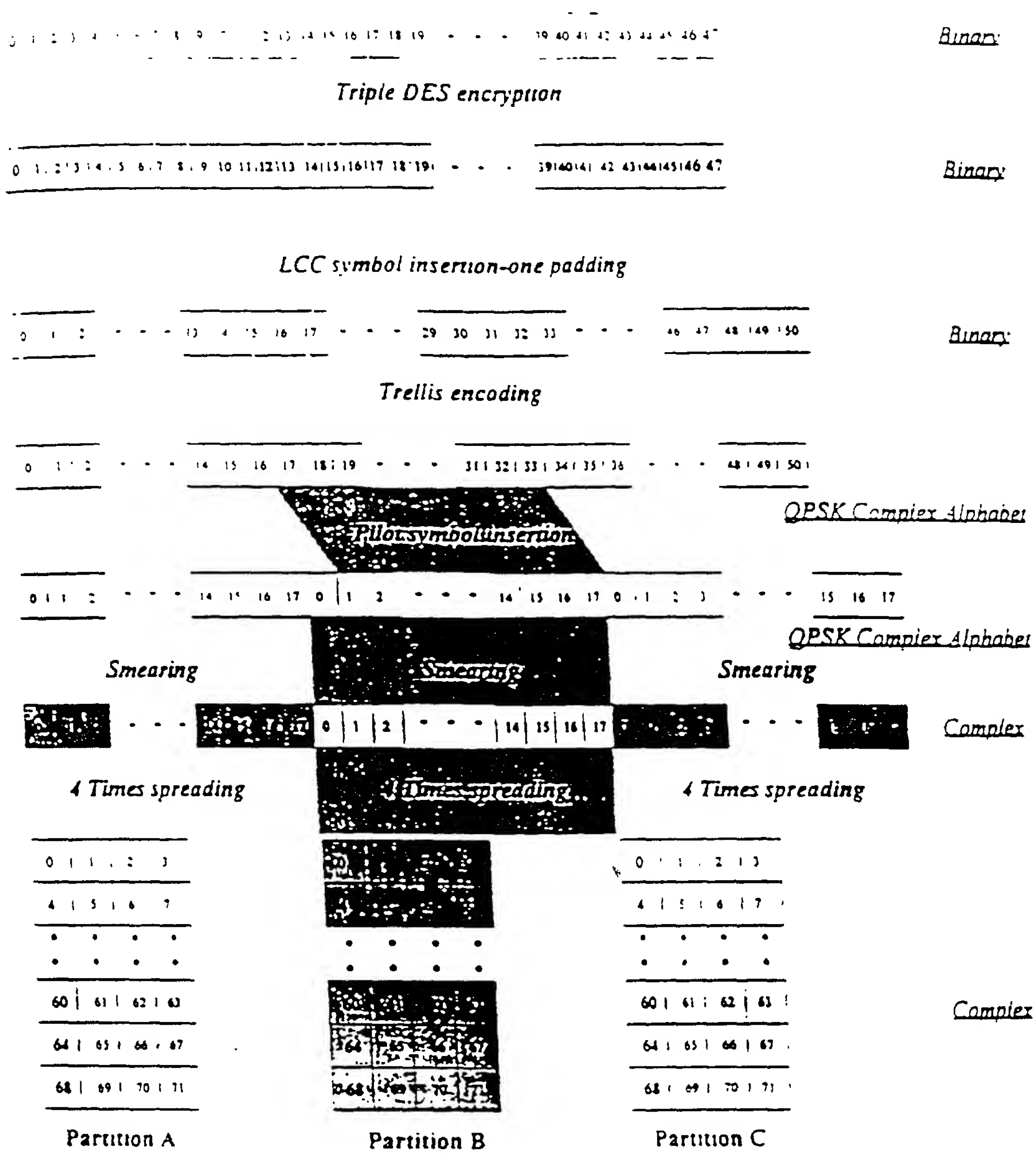


FIG. 63 *RU Tone Mapping of Received Weight Vector Elements*

$w_0 \longrightarrow$ (tone 0)

$w_1 \longrightarrow$ (tone 1)

$w_2 \longrightarrow$ (tone 2)

$w_3 \longrightarrow$ (tone 3)

FIG. 64 Block Diagram Representation of CAC Physical Layer Format

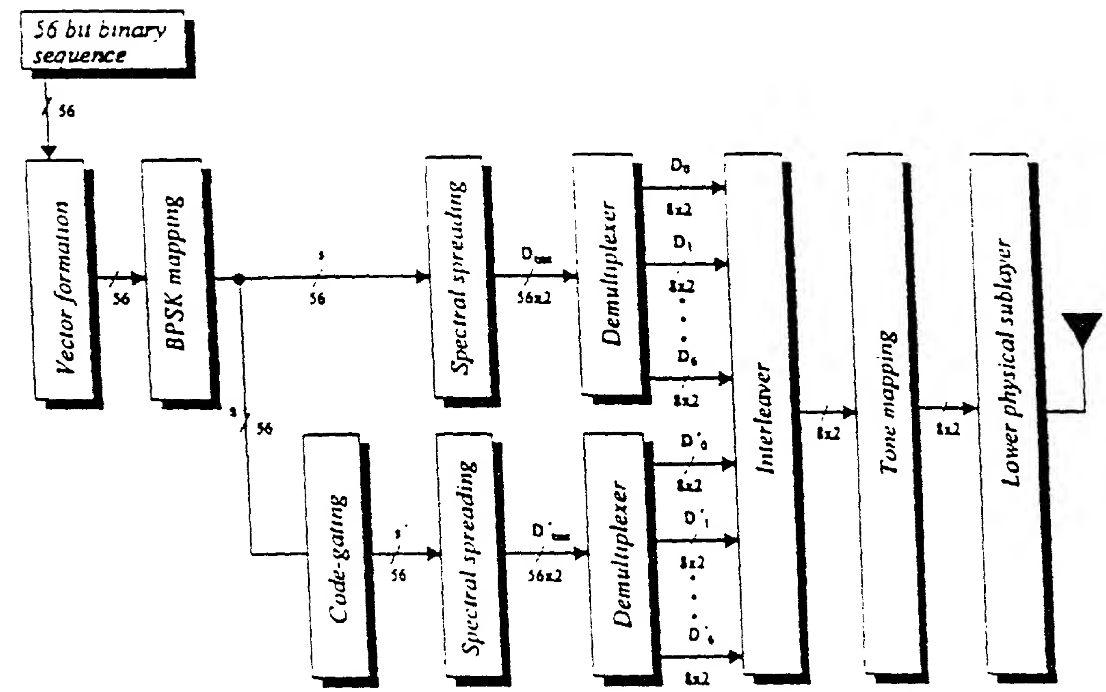


FIG. 65 *BPSK Signal Mapping for the CAC Channel*

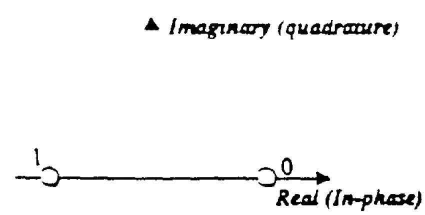


FIG. 65' *BPSK Signal Mapping for the CAC Channel*

Bit	Signal mapping	
	In Phase	Quadrature
0	1	0
1	-1	0

FIG. 66 *The CAC Interleaving Rule*

	Burst number													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Matrix	D_0	D_1	D_2	D_3	D_4	D_5	D_5	D'_6	D'_5	D'_4	D'_3	D'_2	D'_1	D'_0

FIG. 67 *Tone Mapping the (8 x 2) Interleaved Matrix Elements*

		Column Number	
		0	*1*
Row Number	*0*	$CAC_{i,j}(0)$[a]	$CAC_{i,j}(8)$
	1	$CAC_{i,j}(1)$	$CAC_{i,j}(9)$
	2	$CAC_{i,j}(2)$	$CAC_{i,j}(10)$
	3	$CAC_{i,j}(3)$	$CAC_{i,j}(11)$
	4	$CAC_{i,j}(4)$	$CAC_{i,j}(12)$
	5	$CAC_{i,j}(5)$	$CAC_{i,j}(13)$
	6	$CAC_{i,j}(6)$	$CAC_{i,j}(14)$
	7	$CAC_{i,j}(7)$	$CAC_{i,j}(15)$

a. i is the subband pair index (0, 1, 2, or 3) and j is the CAC ID (0 or 1)

FIG. 68 *Functional Block Diagram - Lower Physical Layer of Base Transmitter*

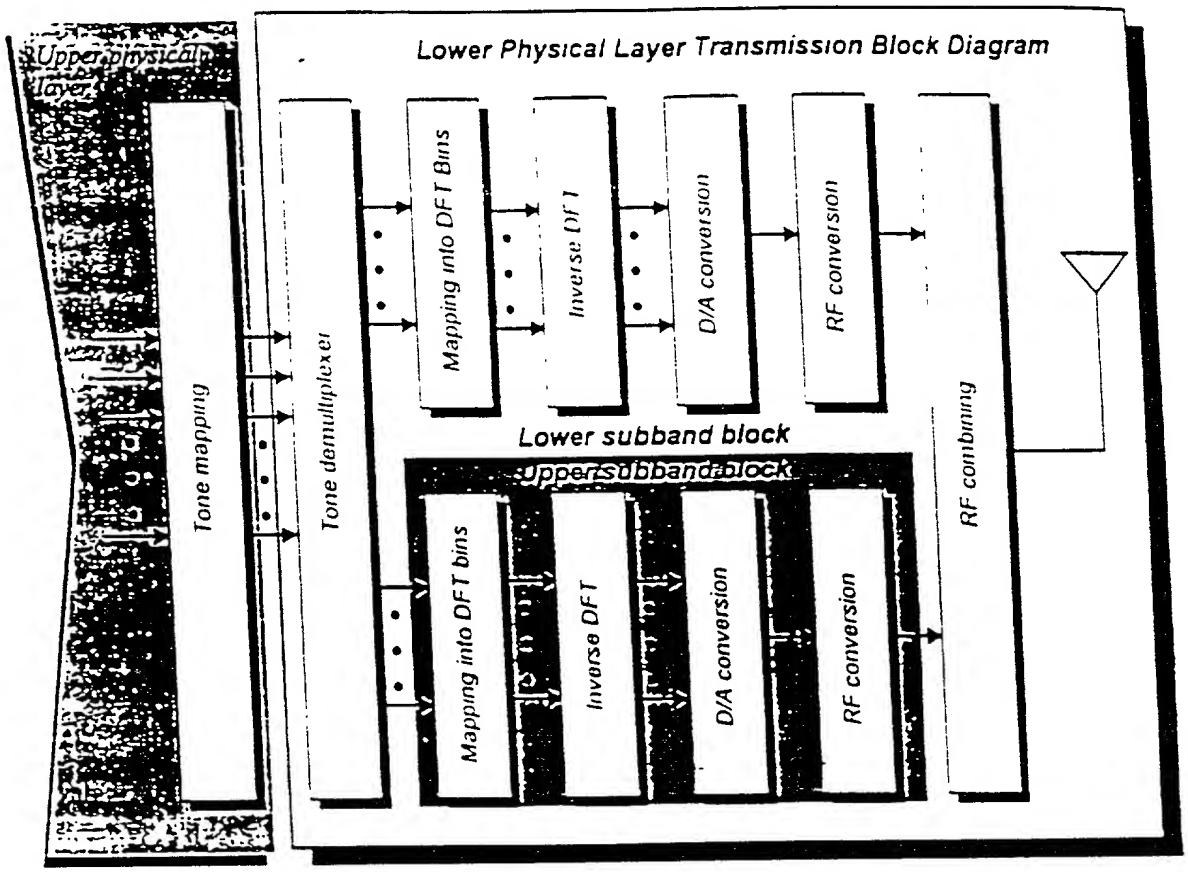
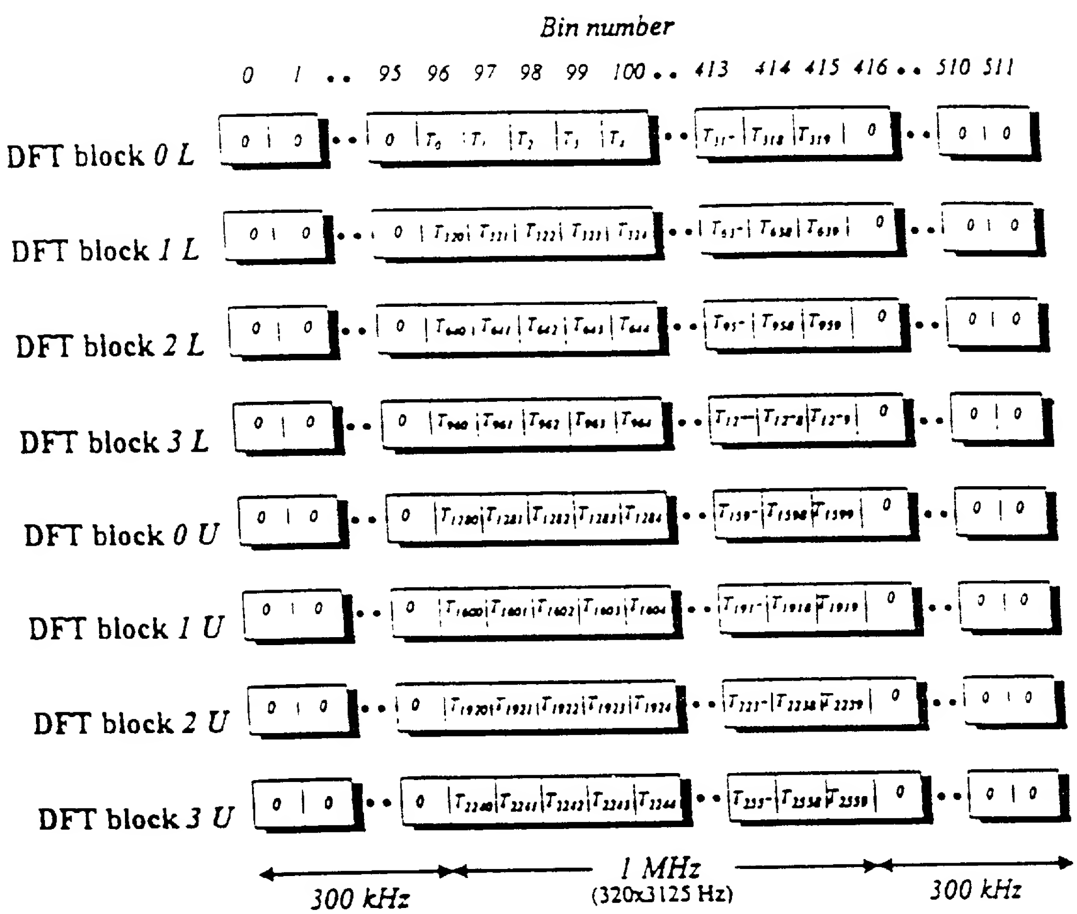


FIG. 69 *Tone Mapping into DFT Bins*

			Bin number		
			Bin 0 to Bin 95	*Bin 96 to Bin 415*	*Bin 416 to Bin 511*
DFT pair	0	*lower*	*Unused*	T_0 to T_{319}	*Unused*
		upper		T_{1280} to T_{1599}	
	1	*lower*		T_{320} to T_{639}	
		upper		T_{1600} to T_{1919}	
	2	*lower*		T_{640} to T_{959}	
		upper		T_{1920} to T_{2239}	
	3	*lower*		T_{960} to T_{1279}	
		upper		T_{2240} to T_{2559}	

FIG. 70 Tone Mapping into DFT Bins



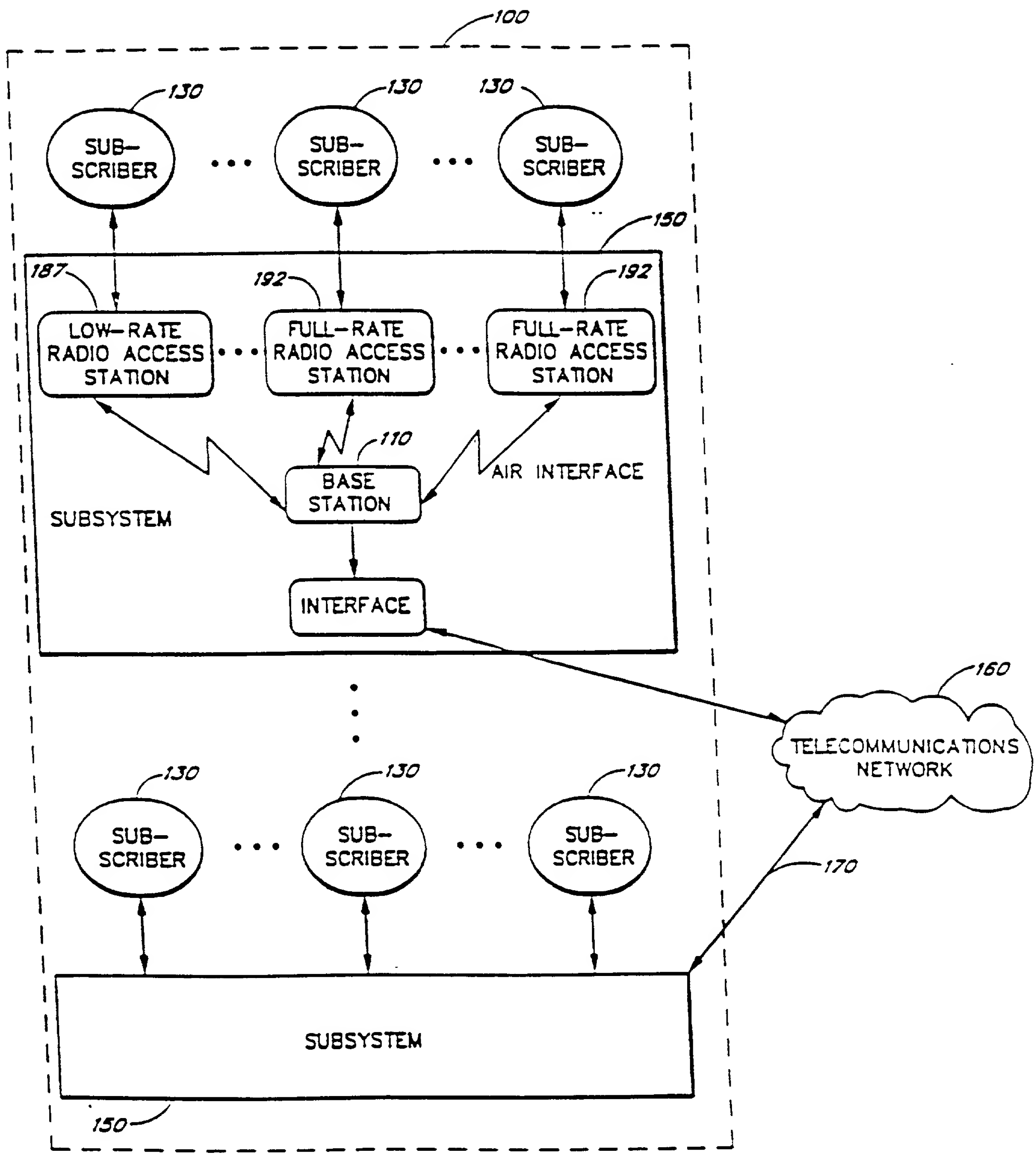

100
130
SUB-SCRIBER
130
SUB-SCRIBER
130
SUB-SCRIBER
150
187
LOW-RATE RADIO ACCESS STATION
192
FULL-RATE RADIO ACCESS STATION
192
FULL-RATE RADIO ACCESS STATION
110
BASE STATION
AIR INTERFACE
SUBSYSTEM
INTERFACE
160
TELECOMMUNICATIONS NETWORK
130
SUB-SCRIBER
130
SUB-SCRIBER
130
SUB-SCRIBER
170
SUBSYSTEM
150

FIG. 71

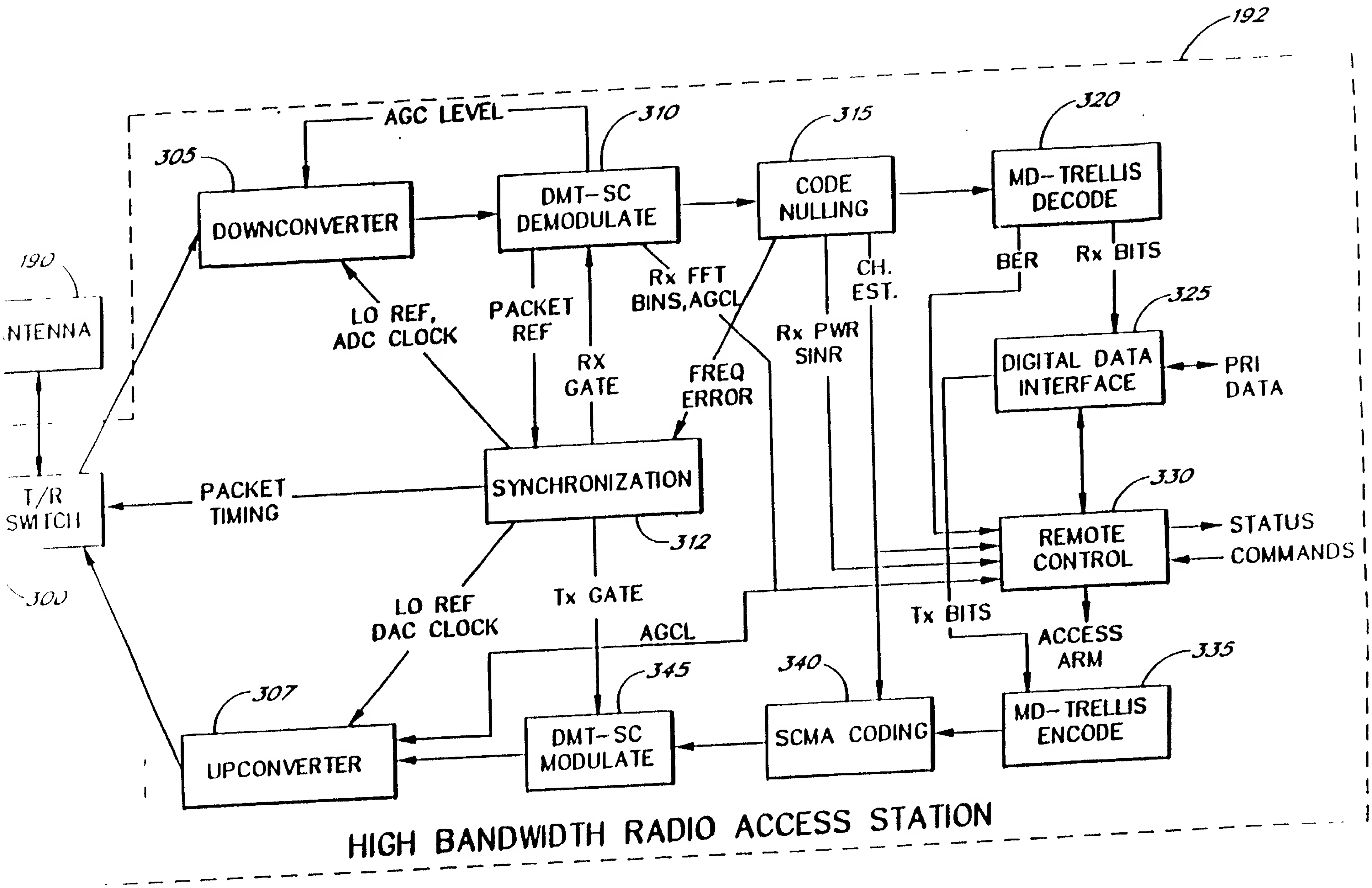
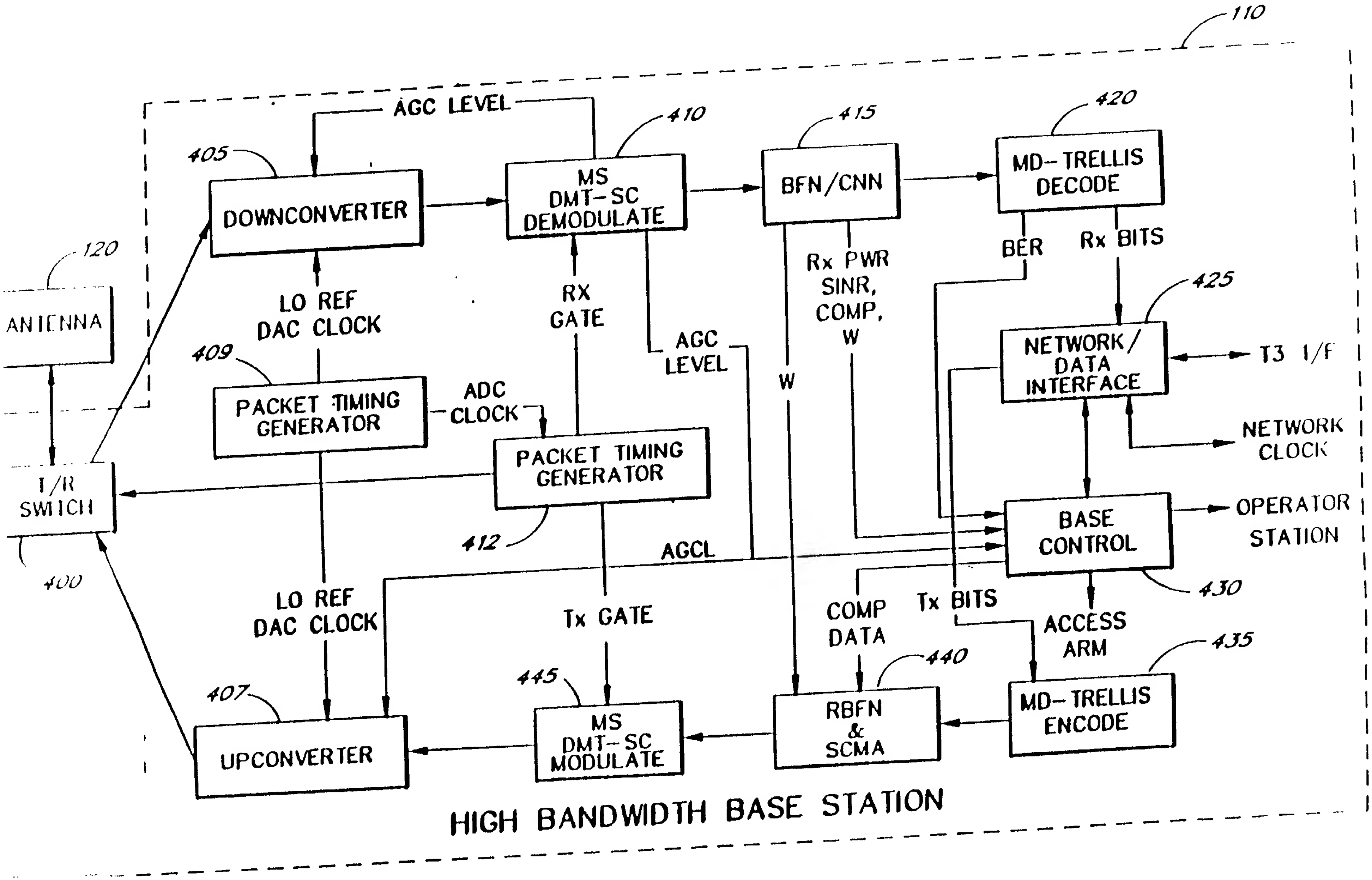

192
AGC LEVEL
305
DOWNCONVERTER
310
DMT-SC DEMODULATE
315
CODE NULLING
320
MD-TRELLIS DECODE
190
ANTENNA
LO REF, ADC CLOCK
PACKET REF
RX GATE
Rx FFT BINS,AGCL
FREQ ERROR
Rx PWR SINR
CH. EST.
BER
Rx BITS
325
DIGITAL DATA INTERFACE
PRI DATA
T/R SWITCH
300
PACKET TIMING
SYNCHRONIZATION
312
330
REMOTE CONTROL
STATUS
COMMANDS
LO REF DAC CLOCK
Tx GATE
AGCL
Tx BITS
ACCESS ARM
307
UPCONVERTER
345
DMT-SC MODULATE
340
SCMA CODING
335
MD-TRELLIS ENCODE
HIGH BANDWIDTH RADIO ACCESS STATION

FIG. 72



110
120
ANTENNA
T/R SWITCH
400
405
DOWNCONVERTER
AGC LEVEL
LO REF DAC CLOCK
409
PACKET TIMING GENERATOR
ADC CLOCK
410
MS DMT-SC DEMODULATE
RX GATE
412
PACKET TIMING GENERATOR
AGC LEVEL
AGCL
415
BFN/CNN
W
Rx PWR SINR, COMP, W
420
MD-TRELLIS DECODE
BER
Rx BITS
425
NETWORK/ DATA INTERFACE
T3 I/F
NETWORK CLOCK
430
BASE CONTROL
OPERATOR STATION
ACCESS ARM
Tx BITS
COMP DATA
435
MD-TRELLIS ENCODE
440
RBFN & SCMA
445
MS DMT-SC MODULATE
Tx GATE
407
UPCONVERTER
LO REF DAC CLOCK
HIGH BANDWIDTH BASE STATION

FIG. 73

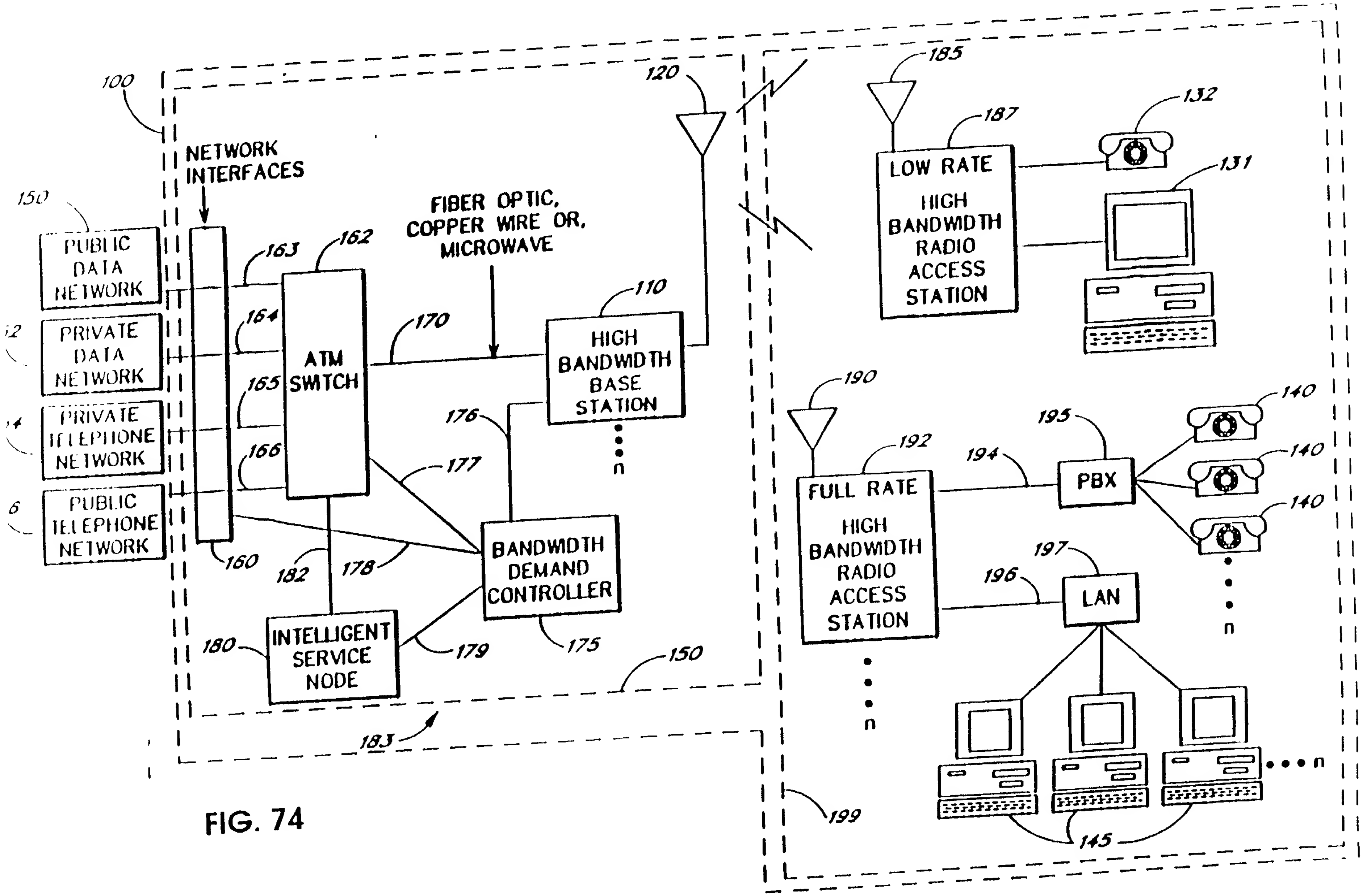
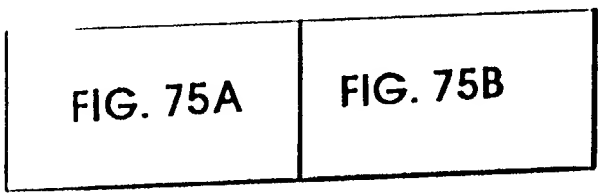

100
150
PUBLIC DATA NETWORK
PRIVATE DATA NETWORK
PRIVATE TELEPHONE NETWORK
PUBLIC TELEPHONE NETWORK
NETWORK INTERFACES
160
163
164
165
166
162
ATM SWITCH
FIBER OPTIC, COPPER WIRE OR, MICROWAVE
170
110
HIGH BANDWIDTH BASE STATION
n
120
176
177
178
182
BANDWIDTH DEMAND CONTROLLER
175
179
INTELLIGENT SERVICE NODE
180
150
183
185
187
LOW RATE HIGH BANDWIDTH RADIO ACCESS STATION
132
131
190
192
FULL RATE HIGH BANDWIDTH RADIO ACCESS STATION
n
194
195
PBX
140
140
140
n
196
197
LAN
n
145
199

FIG. 74

FIG. 75



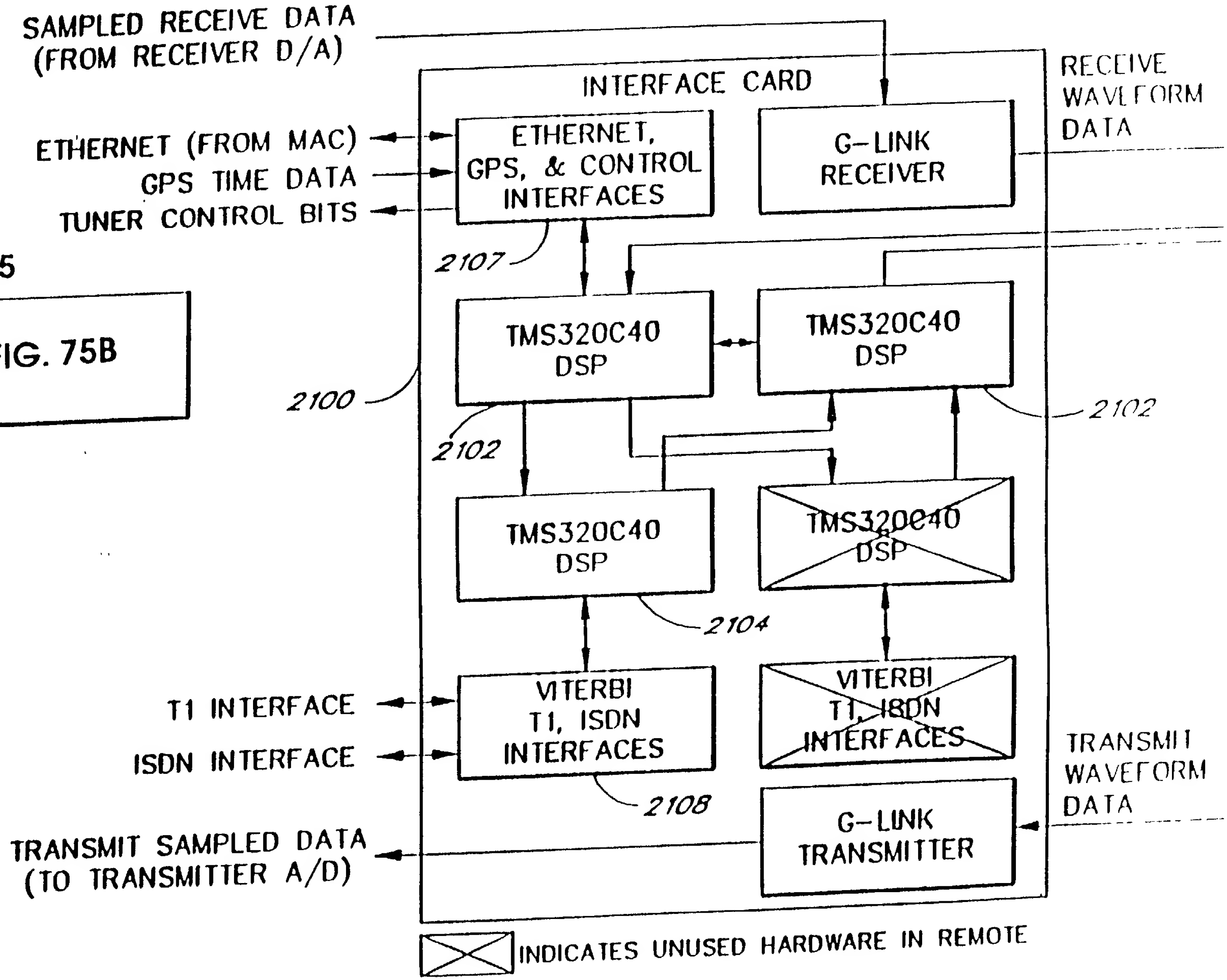


FIG. 75A

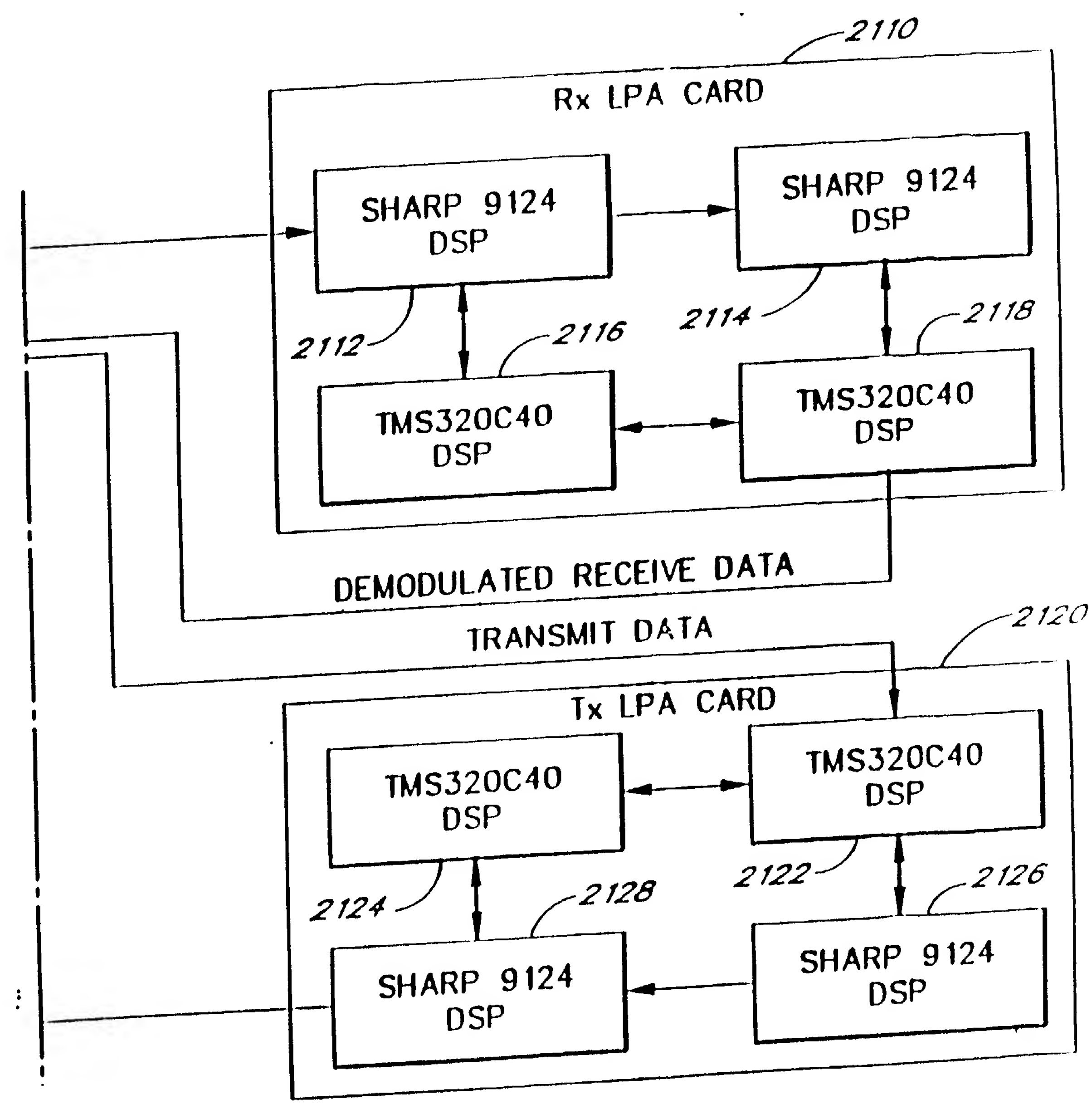

Rx LPA CARD
SHARP 9124 DSP
SHARP 9124 DSP
TMS320C40 DSP
TMS320C40 DSP
2110
2112
2114
2116
2118
DEMODULATED RECEIVE DATA
TRANSMIT DATA
Tx LPA CARD
TMS320C40 DSP
TMS320C40 DSP
SHARP 9124 DSP
SHARP 9124 DSP
2120
2122
2124
2126
2128

FIG. 75B

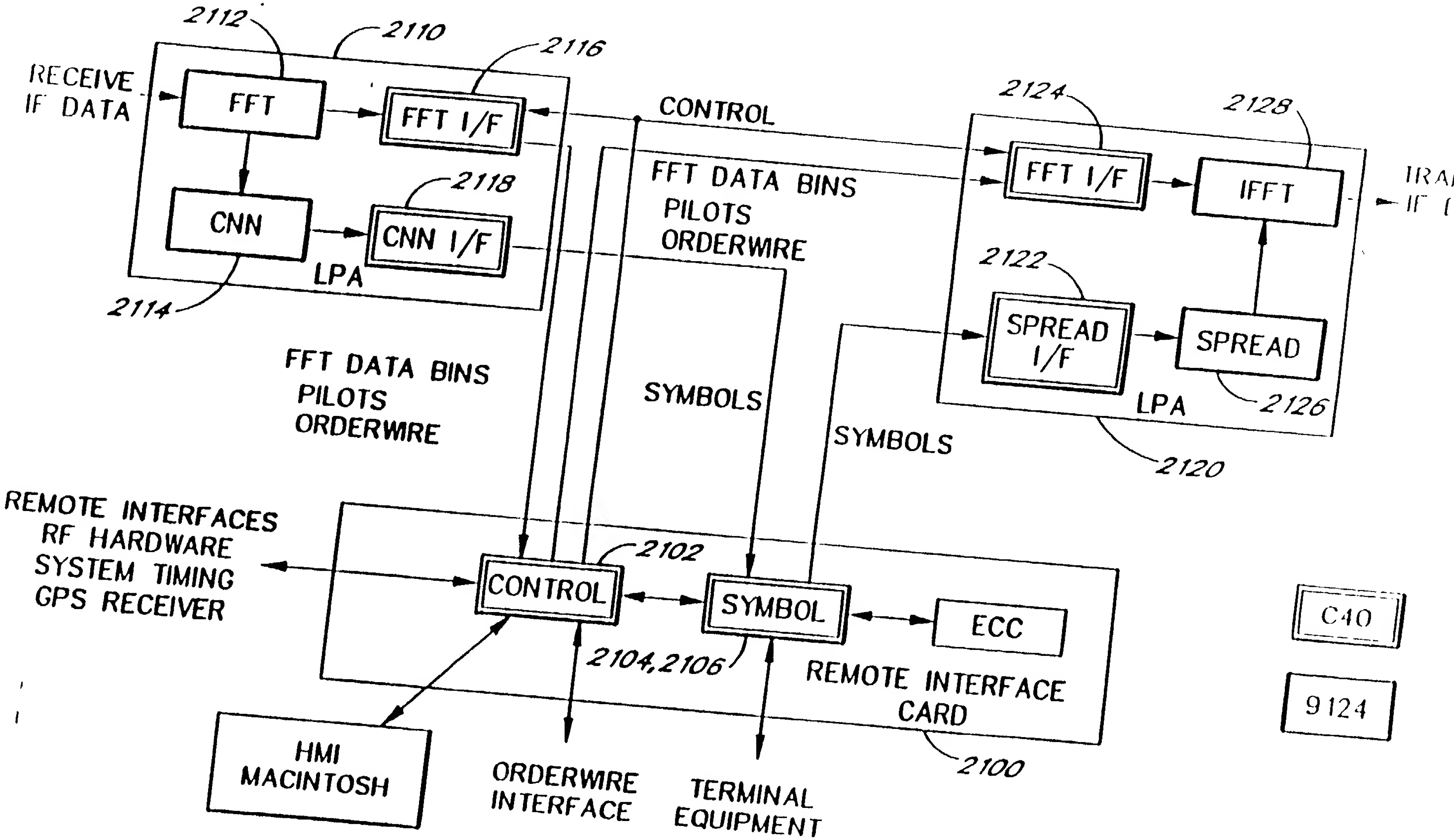

RECEIVE IF DATA
FFT
FFT I/F
CNN
CNN I/F
LPA
2110
2112
2114
2116
2118
CONTROL
FFT DATA BINS
PILOTS
ORDERWIRE
FFT DATA BINS
PILOTS
ORDERWIRE
SYMBOLS
SYMBOLS
FFT I/F
IFFT
SPREAD I/F
SPREAD
LPA
2120
2122
2124
2126
2128
REMOTE INTERFACES
RF HARDWARE
SYSTEM TIMING
GPS RECEIVER
CONTROL
SYMBOL
ECC
2102
2104,2106
REMOTE INTERFACE CARD
2100
HMI MACINTOSH
ORDERWIRE INTERFACE
TERMINAL EQUIPMENT
C40
9124

FIG. 76

FIG. 77A

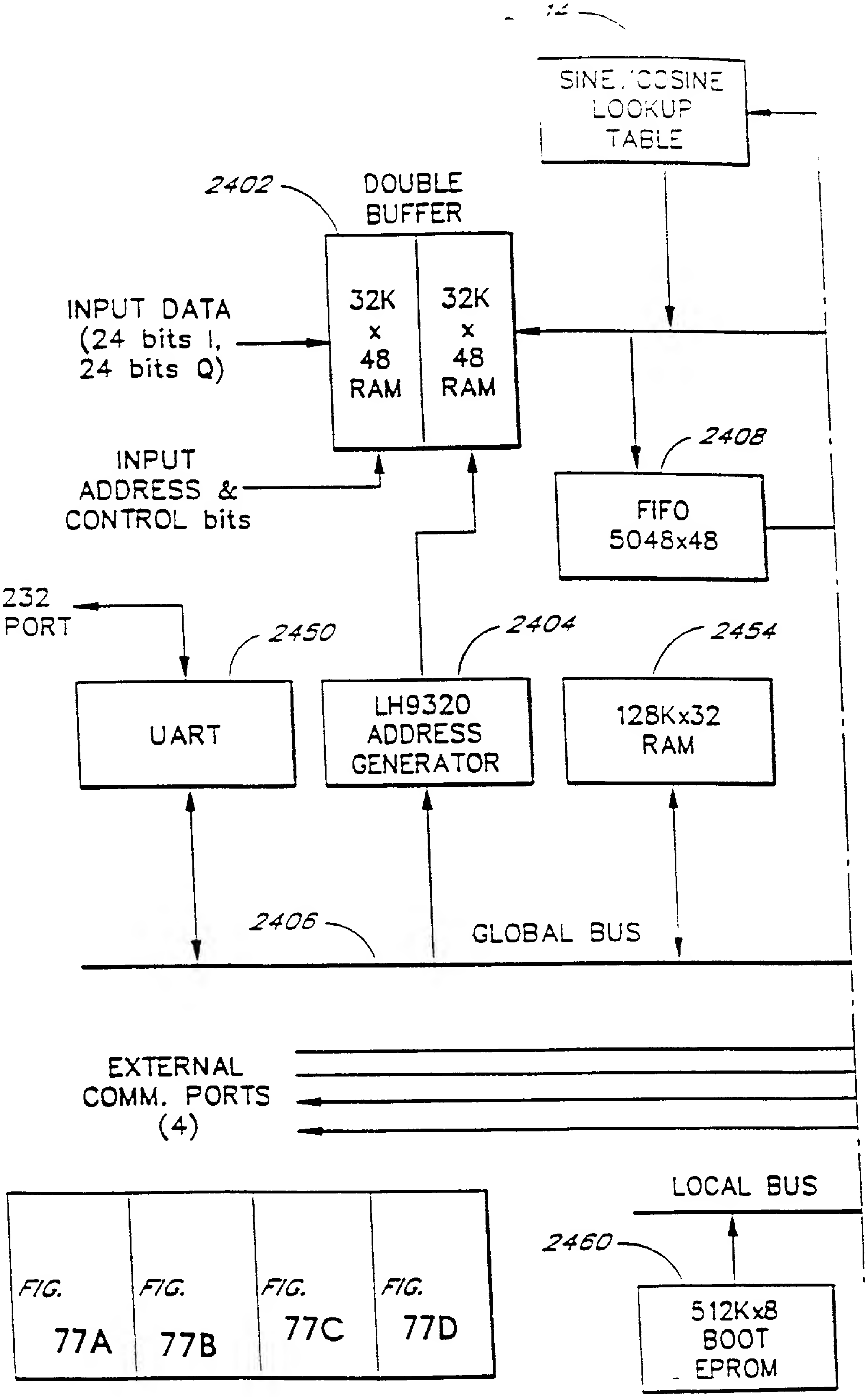
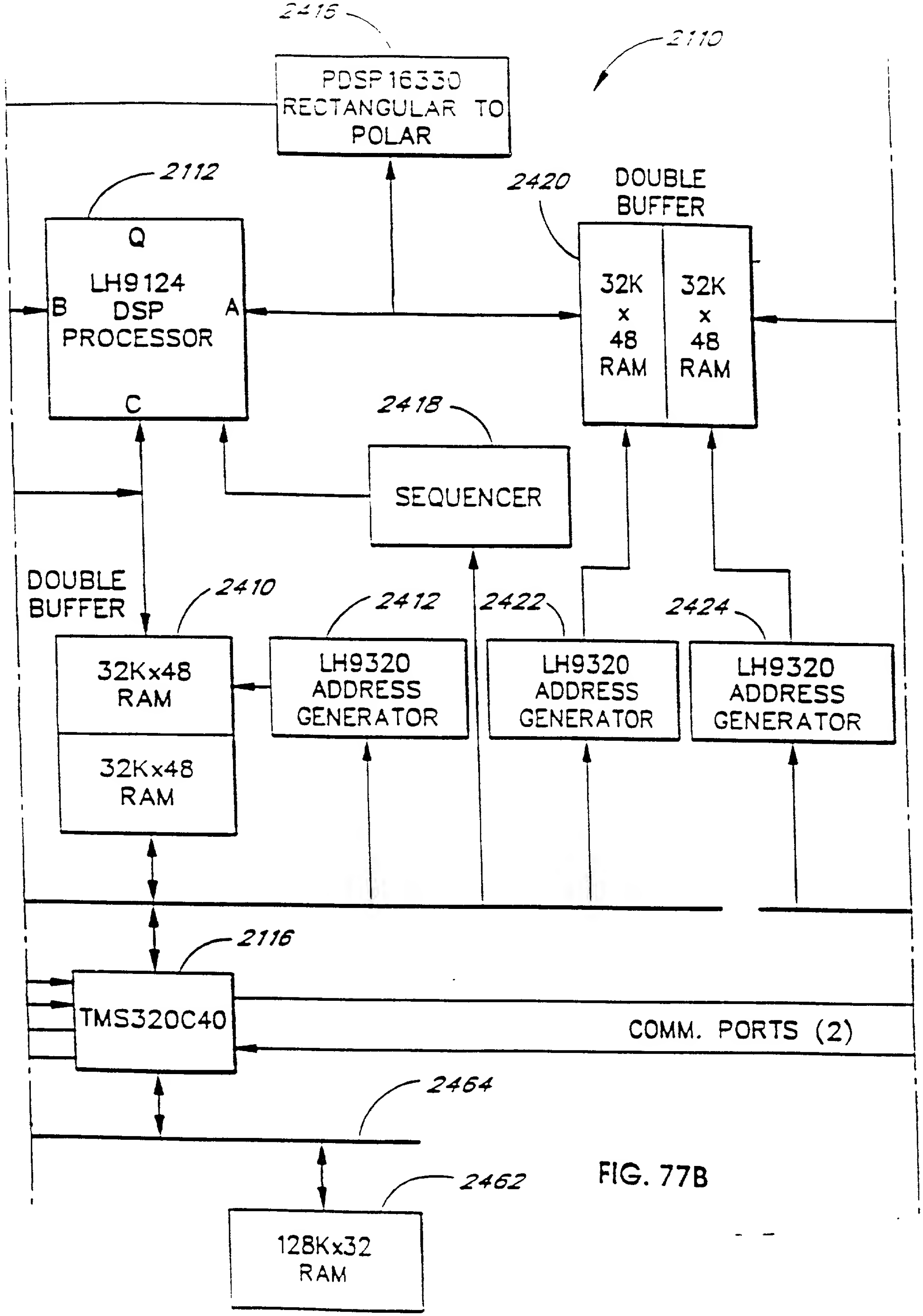


FIG. 77


2416
2110
PDSP 16330
RECTANGULAR TO
POLAR
2112
2420
DOUBLE
BUFFER
Q
LH9124
DSP
PROCESSOR
B
A
C
32K
x
48
RAM
32K
x
48
RAM
2418
SEQUENCER
DOUBLE
BUFFER
2410
2412
2422
2424
32Kx48
RAM
32Kx48
RAM
LH9320
ADDRESS
GENERATOR
LH9320
ADDRESS
GENERATOR
LH9320
ADDRESS
GENERATOR
2116
TMS320C40
COMM. PORTS (2)
2464
2462
128Kx32
RAM
FIG. 77B

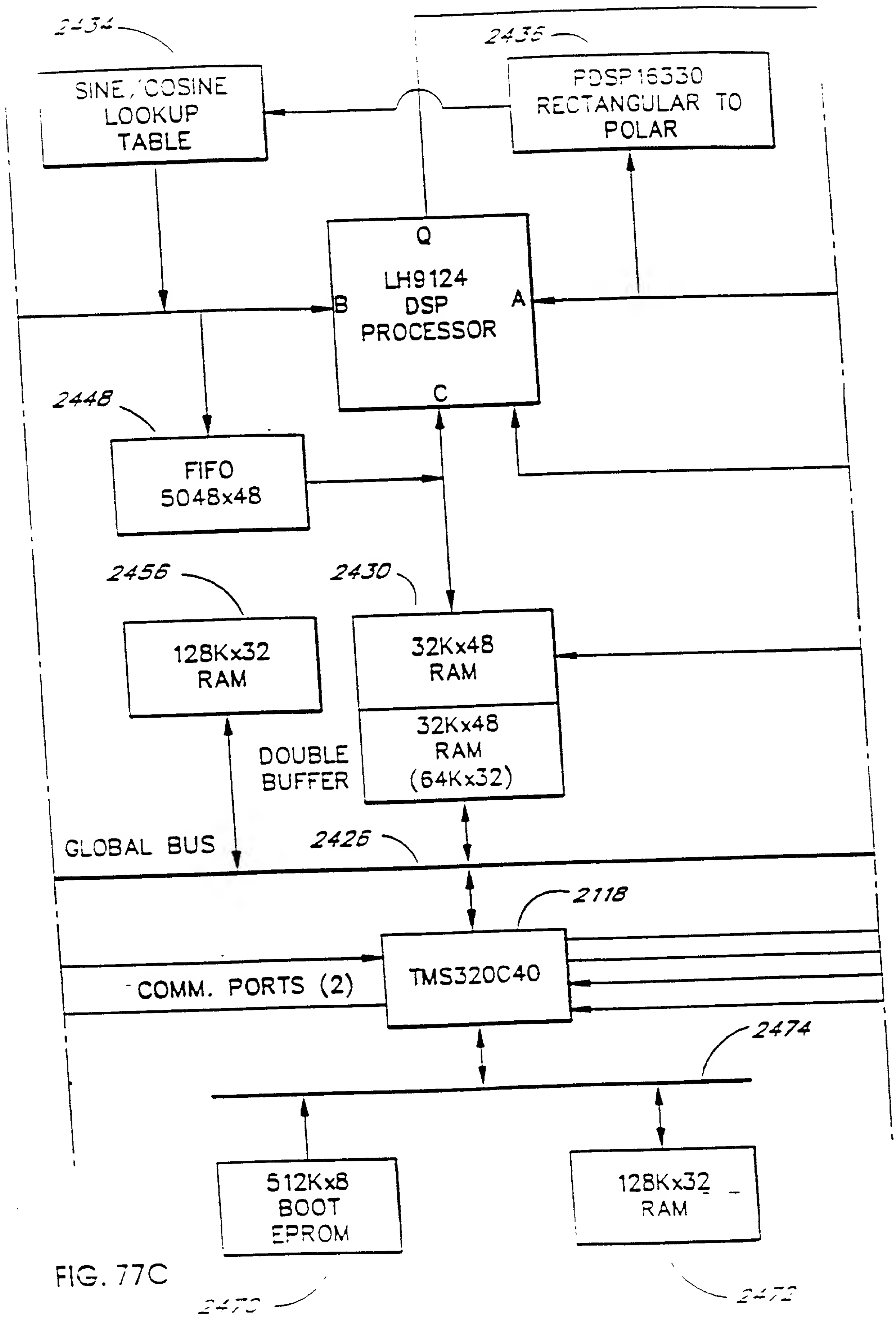

2434
SINE/COSINE LOOKUP TABLE
2436
PDSP16330 RECTANGULAR TO POLAR
Q
LH9124 DSP PROCESSOR
B
A
C
2448
FIFO 5048x48
2456
2430
128Kx32 RAM
32Kx48 RAM
32Kx48 RAM (64Kx32)
DOUBLE BUFFER
GLOBAL BUS
2426
2118
TMS320C40
COMM. PORTS (2)
2474
512Kx8 BOOT EPROM
128Kx32 RAM
2470
2472

FIG. 77C

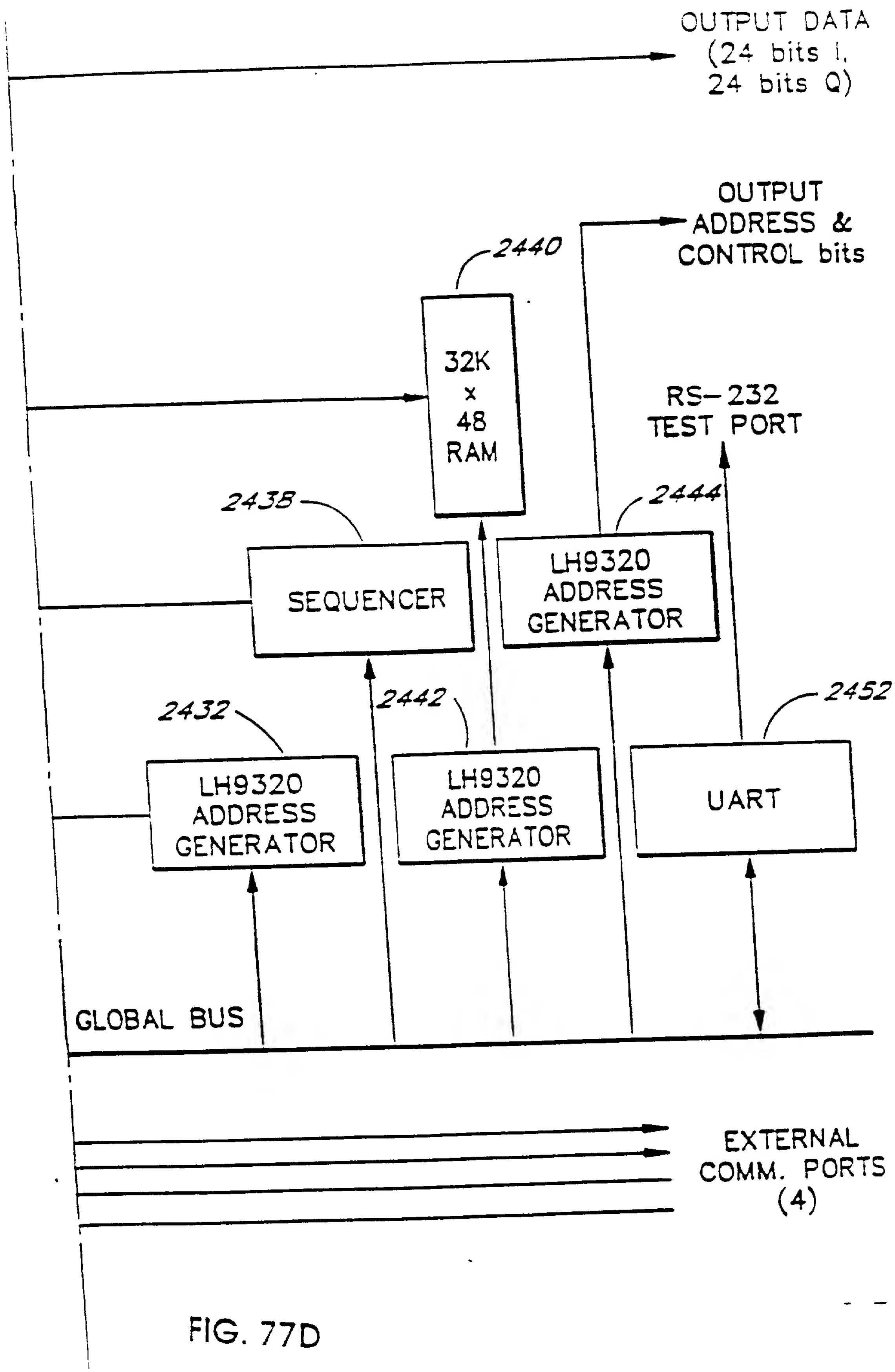
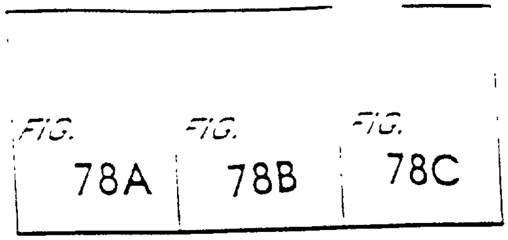

OUTPUT DATA (24 bits I, 24 bits Q)
OUTPUT ADDRESS & CONTROL bits
2440
32K x 48 RAM
RS-232 TEST PORT
2438
SEQUENCER
2444
LH9320 ADDRESS GENERATOR
2432
2442
2452
LH9320 ADDRESS GENERATOR
LH9320 ADDRESS GENERATOR
UART
GLOBAL BUS
EXTERNAL COMM. PORTS (4)

FIG. 77D

FIG. 78



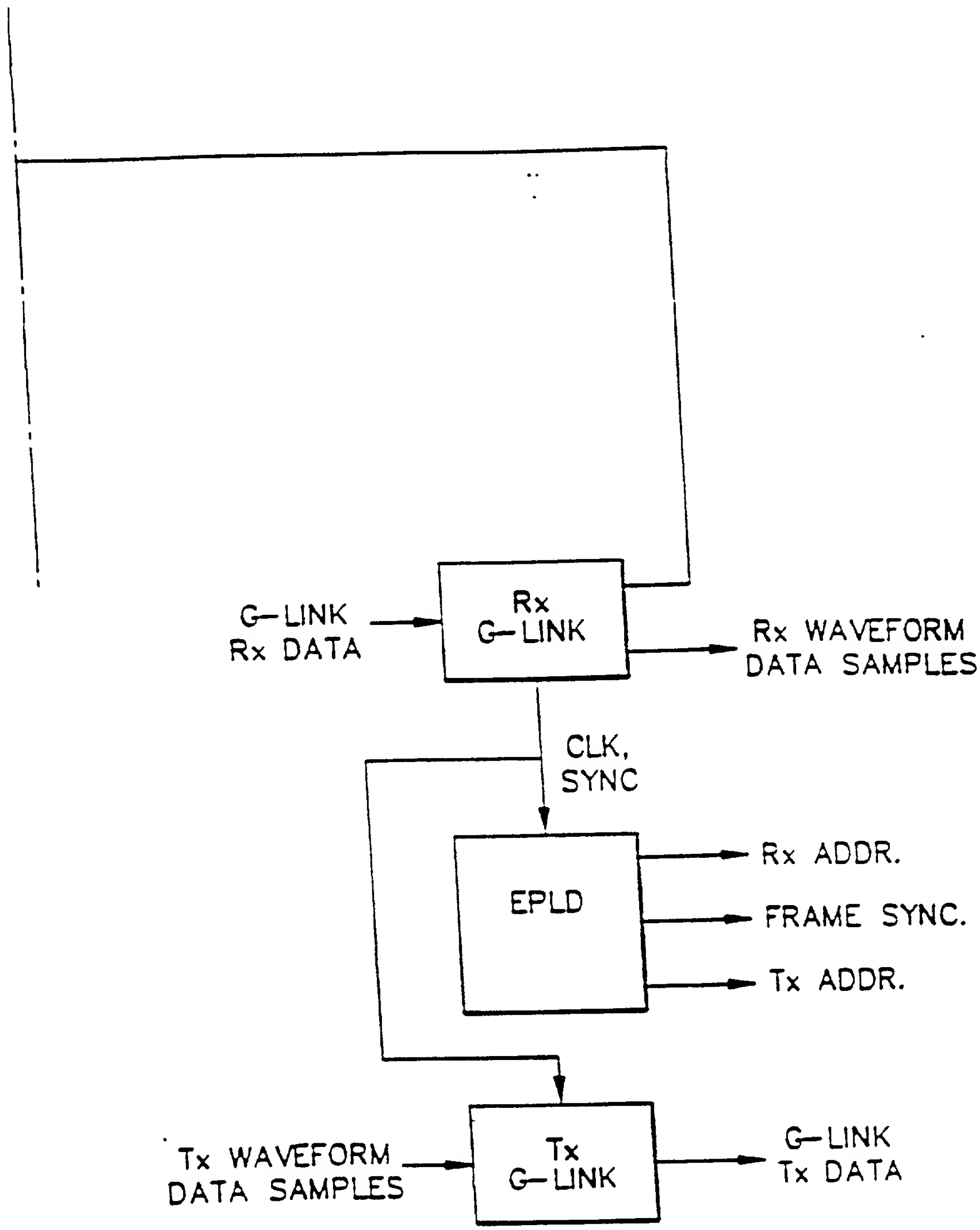
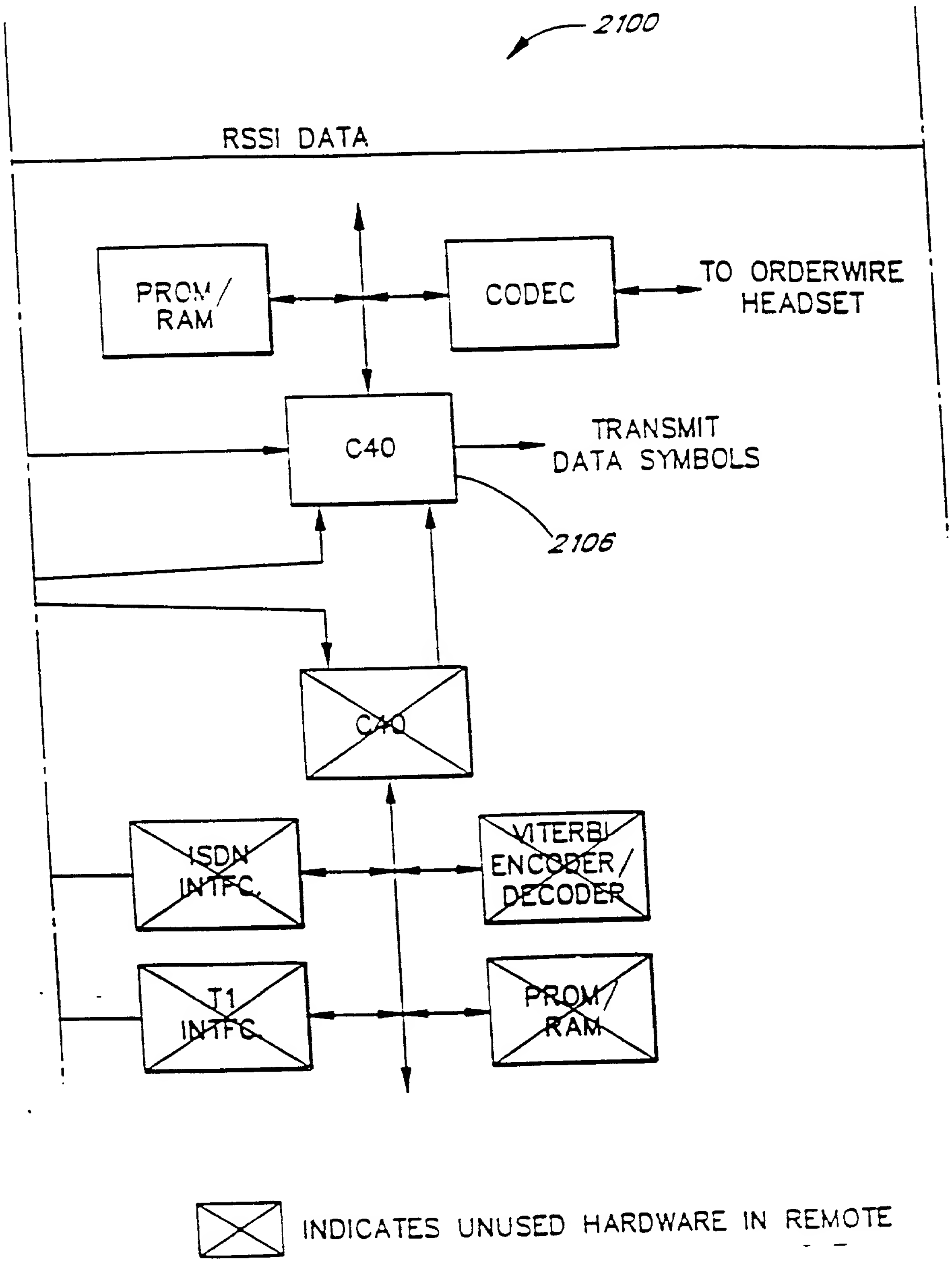


FIG. 78A

FIG. 78B


2100
RSSI DATA
PROM/
RAM
CODEC
TO ORDERWIRE
HEADSET
C40
TRANSMIT
DATA SYMBOLS
2106
C40
ISDN
INTFC.
VITERBI
ENCODER/
DECODER
T1
INTFC.
PROM/
RAM
INDICATES UNUSED HARDWARE IN REMOTE

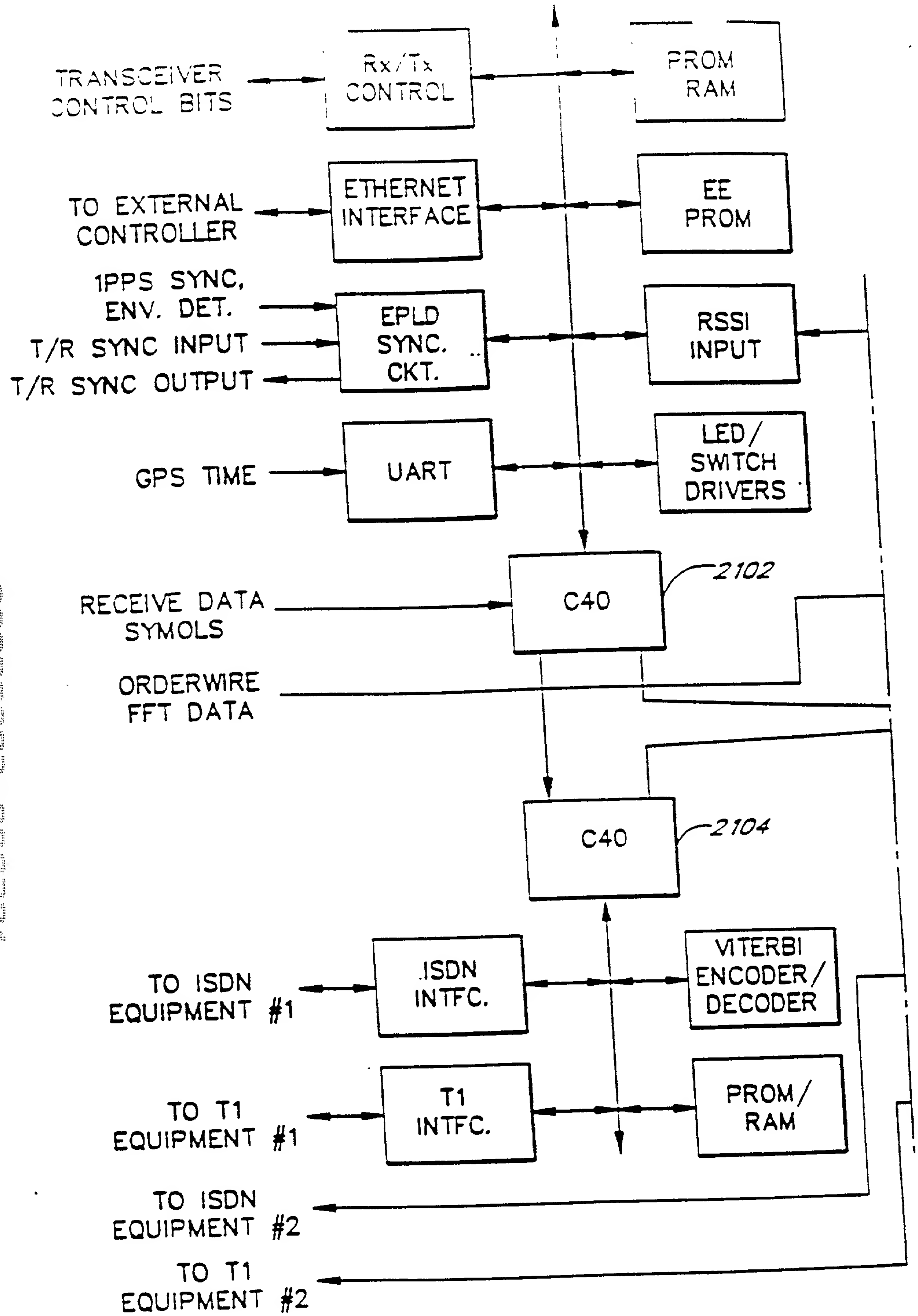

TRANSCEIVER CONTROL BITS
Rx/Tx CONTROL
PROM RAM
TO EXTERNAL CONTROLLER
ETHERNET INTERFACE
EE PROM
1PPS SYNC, ENV. DET.
T/R SYNC INPUT
T/R SYNC OUTPUT
EPLD SYNC. CKT.
RSSI INPUT
GPS TIME
UART
LED/ SWITCH DRIVERS
RECEIVE DATA SYMOLS
C40
2102
ORDERWIRE FFT DATA
C40
2104
TO ISDN EQUIPMENT #1
ISDN INTFC.
VITERBI ENCODER/ DECODER
TO T1 EQUIPMENT #1
T1 INTFC.
PROM/ RAM
TO ISDN EQUIPMENT #2
TO T1 EQUIPMENT #2

FIG. 78C

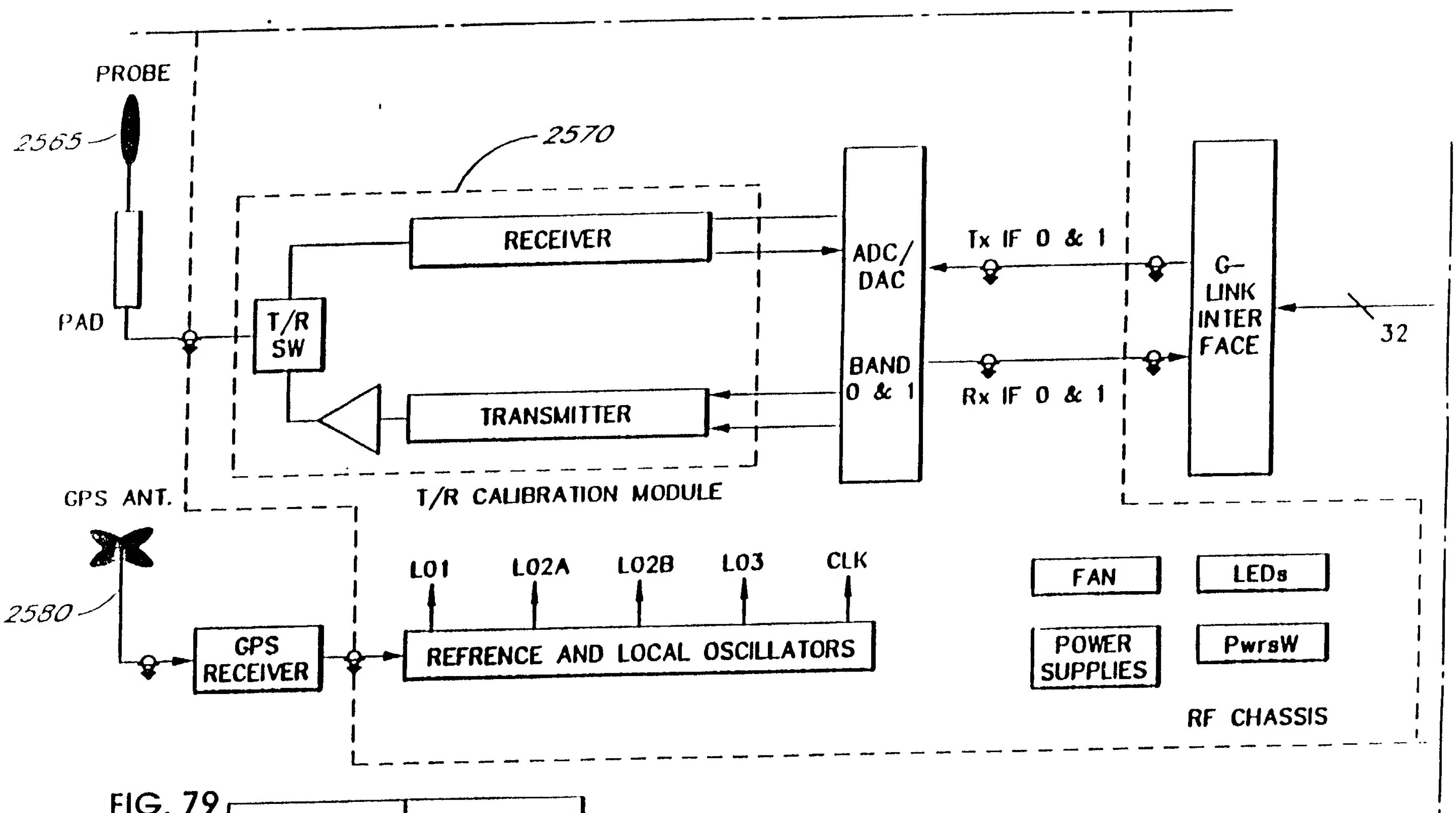
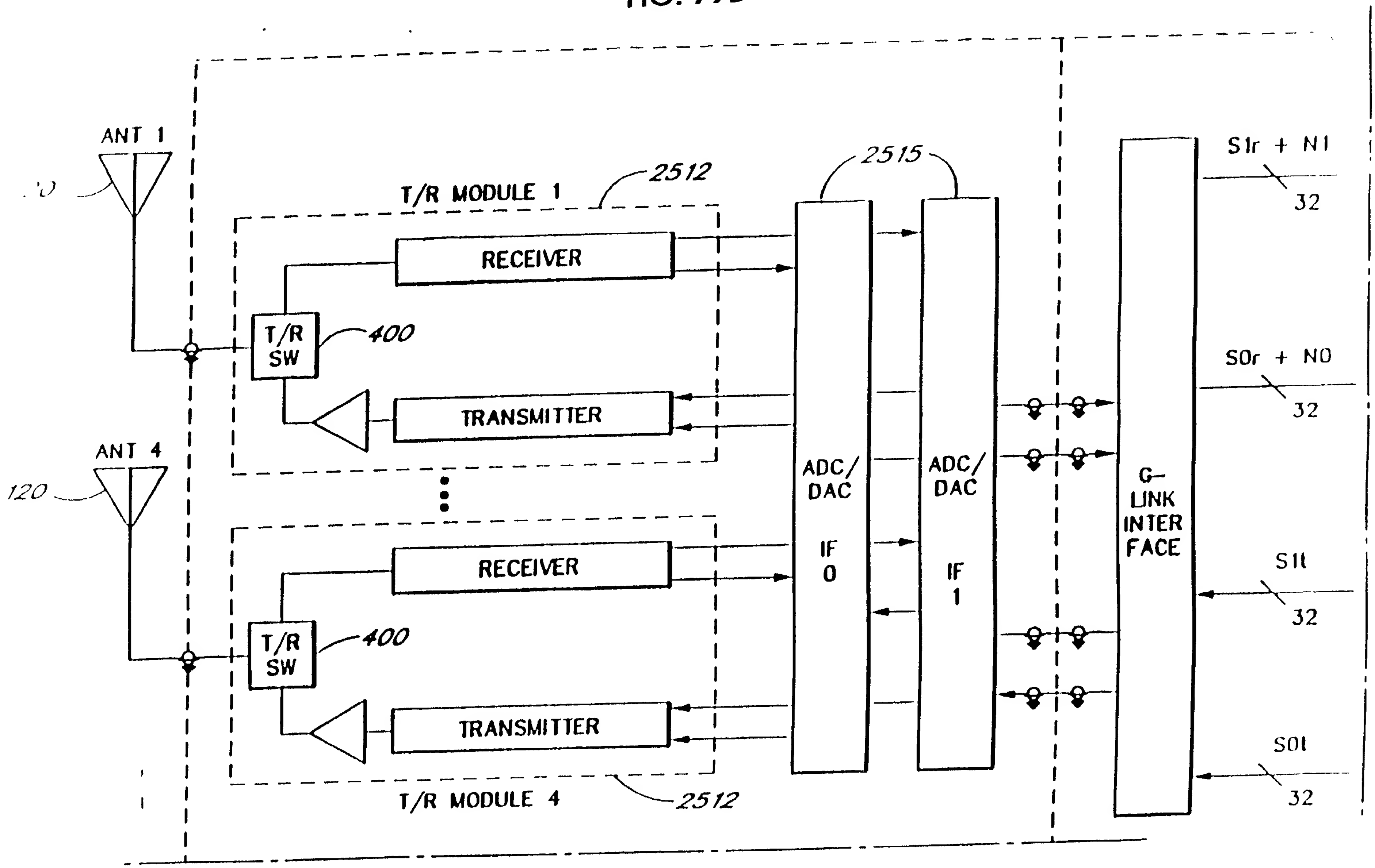


FIG. 79

FIG. 79B	FIG. 79C
FIG. 79A	FIG. 79D

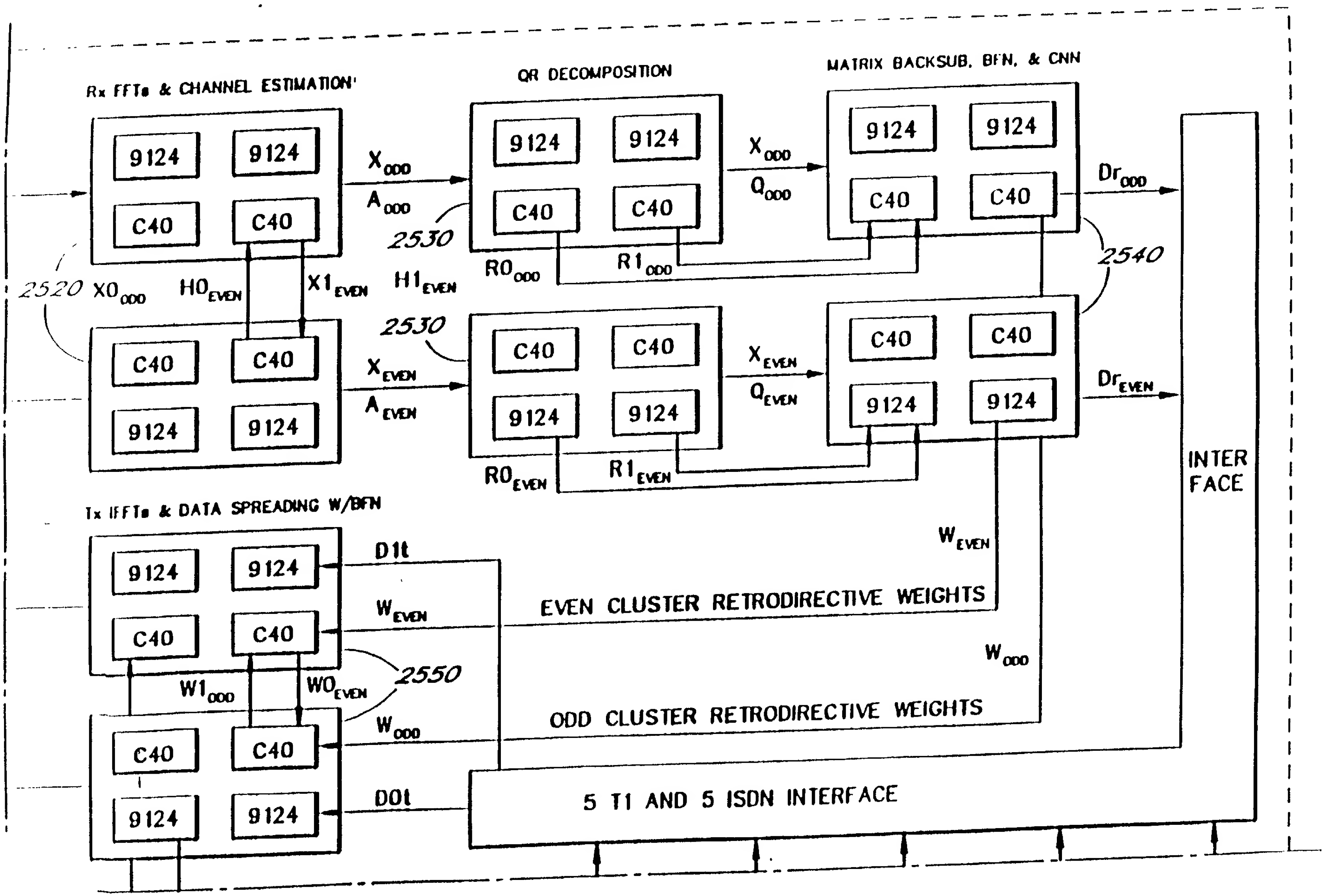
FIG. 79A

FIG. 79B



ANT 1
ANT 4
120
T/R MODULE 1
T/R MODULE 4
2512
2512
RECEIVER
TRANSMITTER
RECEIVER
TRANSMITTER
T/R SW
T/R SW
400
400
2515
ADC/ DAC IF 0
ADC/ DAC IF 1
G-LINK INTER FACE
S1r + N1
S0r + N0
S1t
S0t
32
32
32
32

FIG. 79C


Rx FFTs & CHANNEL ESTIMATION
QR DECOMPOSITION
MATRIX BACKSUB, BFN, & CNN
Tx IFFTs & DATA SPREADING W/BFN
9124
C40
X ODD
A ODD
Q ODD
X EVEN
A EVEN
Q EVEN
Dr ODD
Dr EVEN
R0 ODD
R1 ODD
R0 EVEN
R1 EVEN
X0 ODD
H0 EVEN
X1 EVEN
H1 EVEN
2520
2530
2540
2550
D1t
D0t
W EVEN
W ODD
W1 ODD
W0 EVEN
EVEN CLUSTER RETRODIRECTIVE WEIGHTS
ODD CLUSTER RETRODIRECTIVE WEIGHTS
5 T1 AND 5 ISDN INTERFACE
INTER FACE

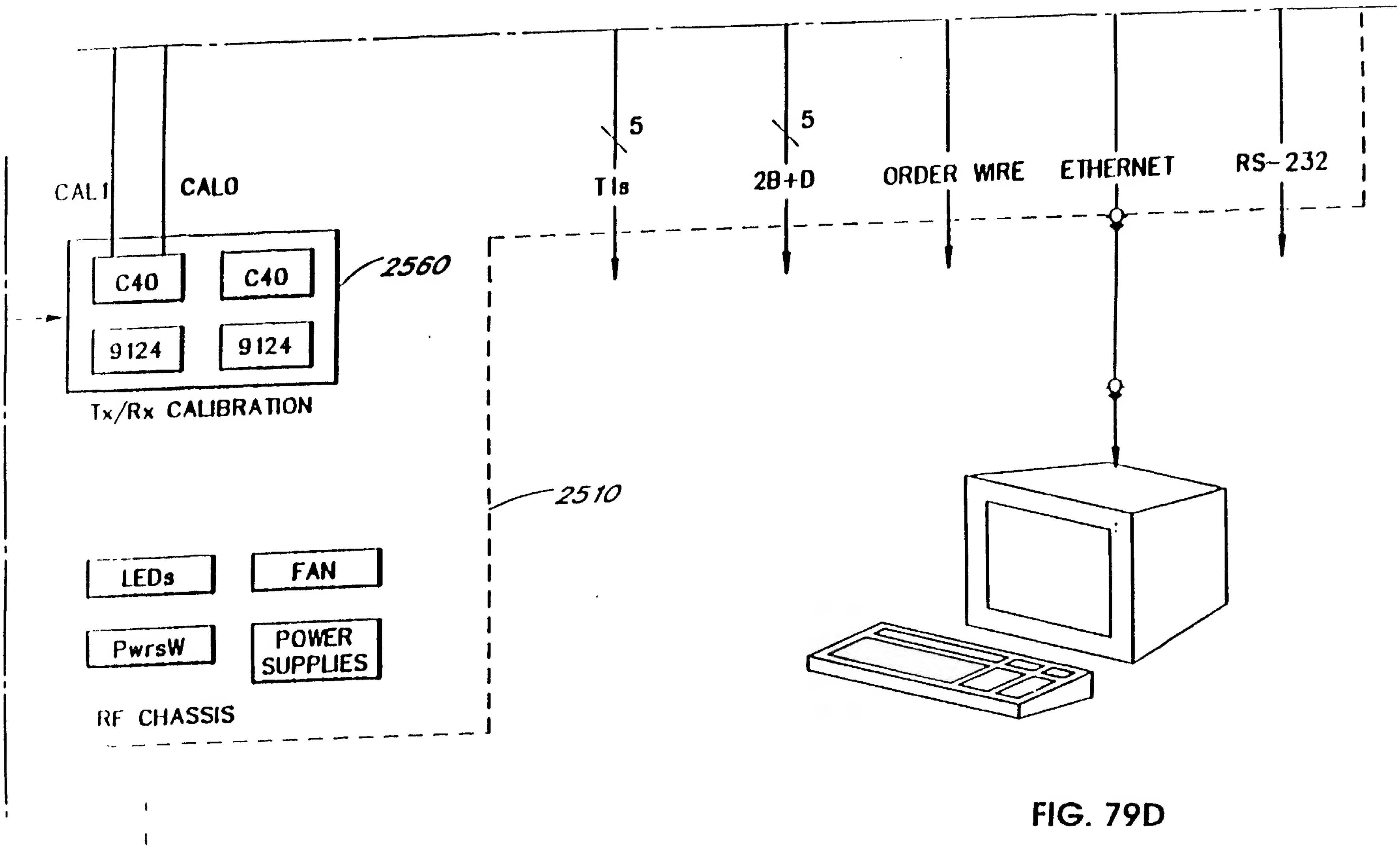

CAL1
CALO
C40
C40
9124
9124
2560
Tx/Rx CALIBRATION
5
T1s
5
2B+D
ORDER WIRE
ETHERNET
RS-232
2510
LEDs
FAN
PwrsW
POWER SUPPLIES
RF CHASSIS

FIG. 79D

FIG. 80A

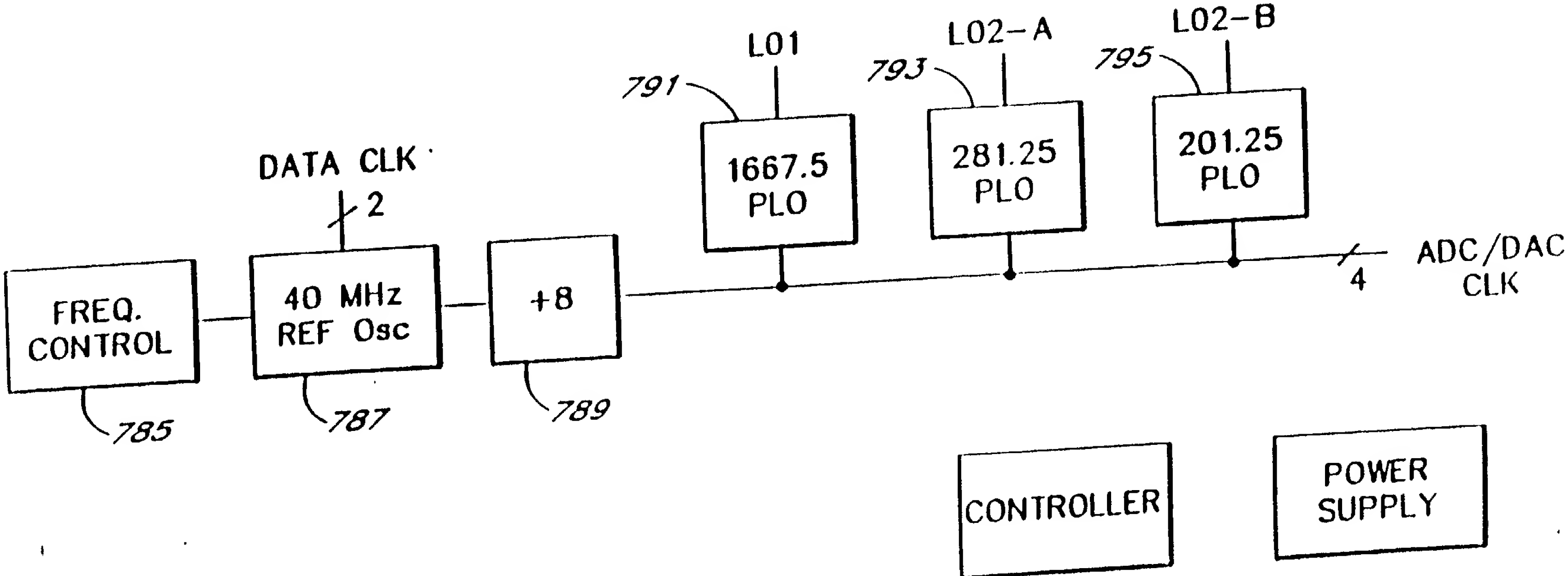
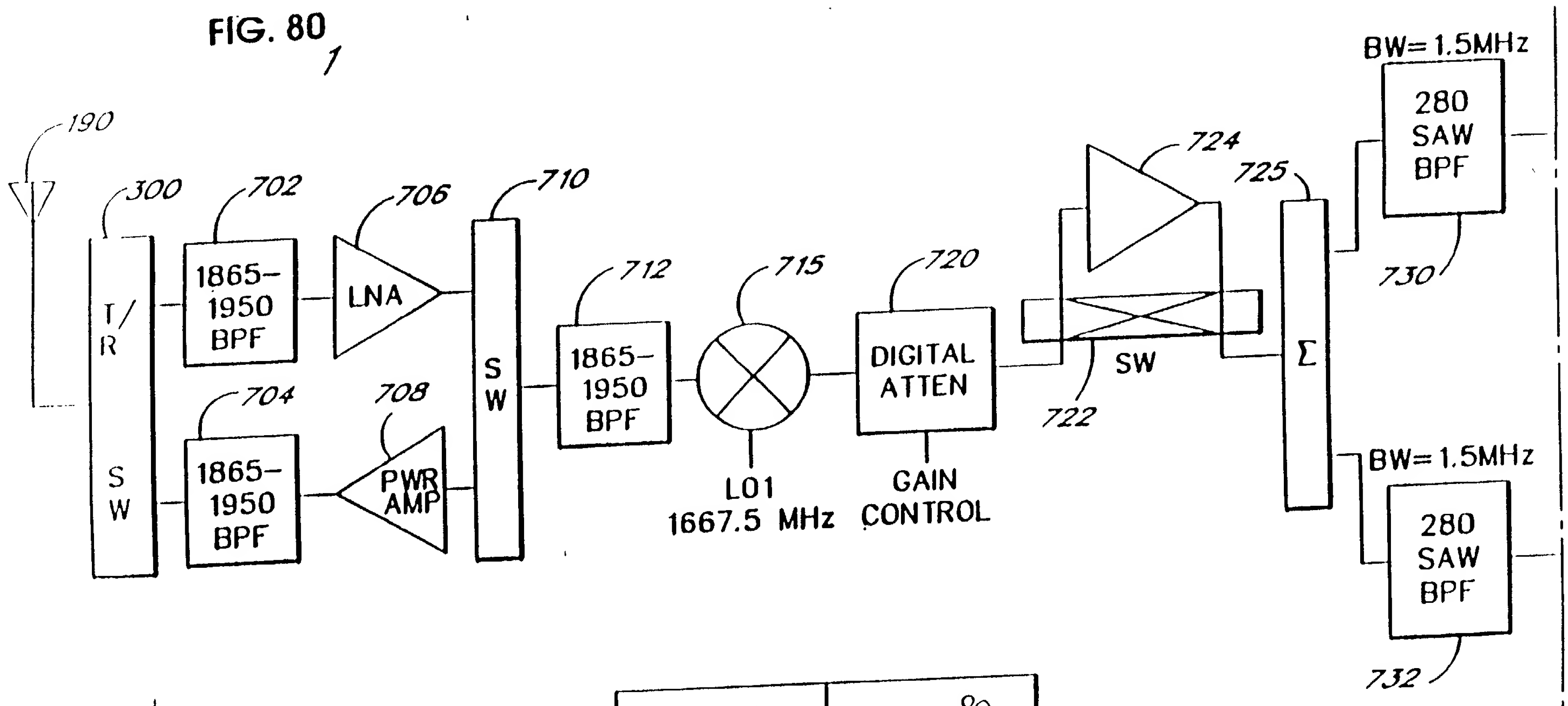

L01
L02-A
L02-B
791
793
795
DATA CLK
2
1667.5
PLO
281.25
PLO
201.25
PLO
FREQ.
CONTROL
40 MHz
REF Osc
+8
ADC/DAC
CLK
4
785
787
789
CONTROLLER
POWER
SUPPLY

FIG. 80$_1$



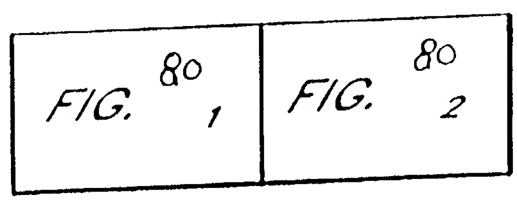
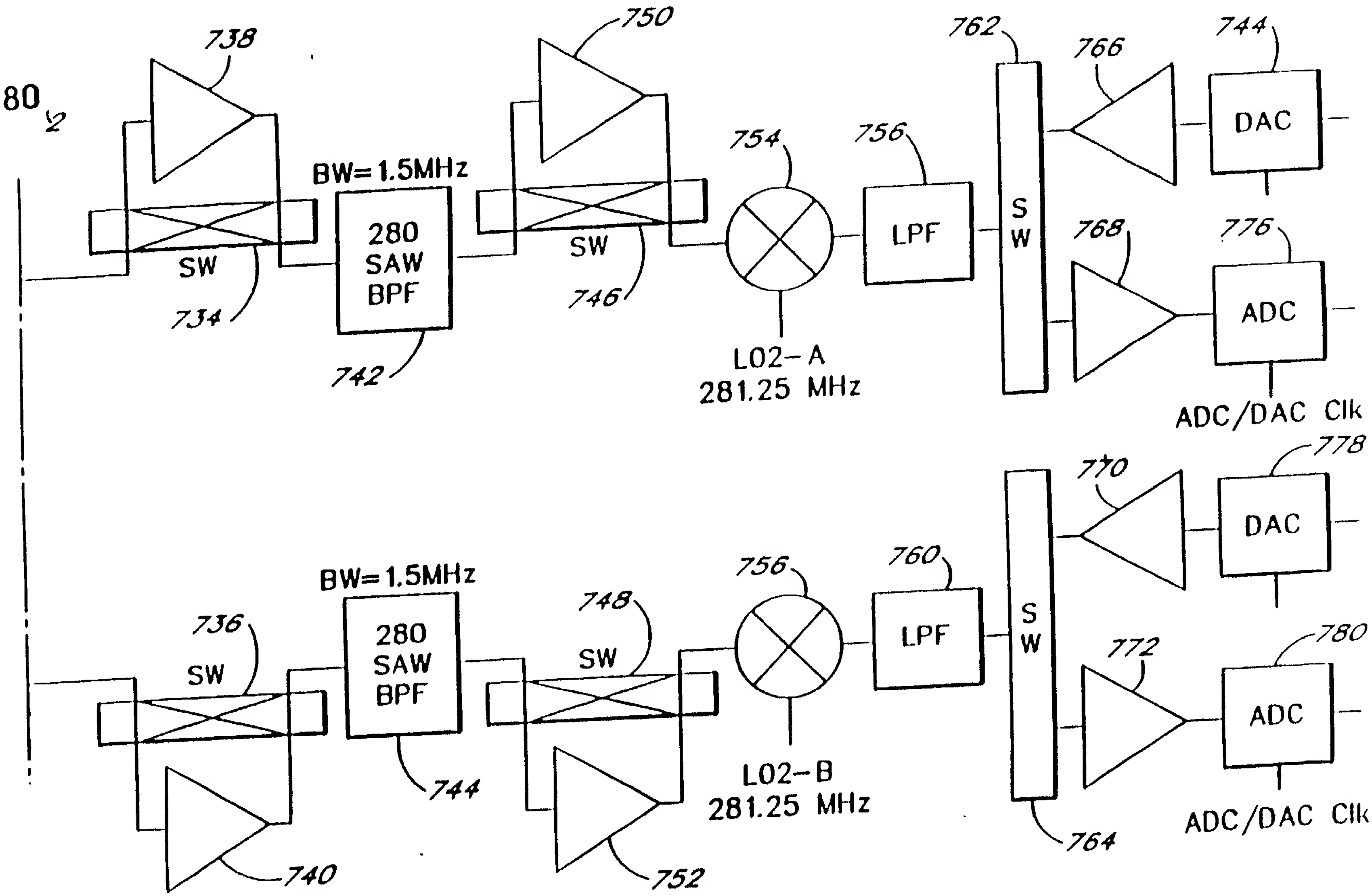


FIG. 80

FIG. 80₂



738
734
SW
BW=1.5MHz
280
SAW
BPF
742
750
SW
746
754
L02– A
281.25 MHz
756
LPF
762
S
W
766
744
DAC
768
776
ADC
ADC/DAC Clk
736
SW
BW=1.5MHz
280
SAW
BPF
744
740
748
SW
752
756
L02–B
281.25 MHz
760
LPF
S
W
764
770
778
DAC
772
780
ADC
ADC/DAC Clk

FIG. 81₁

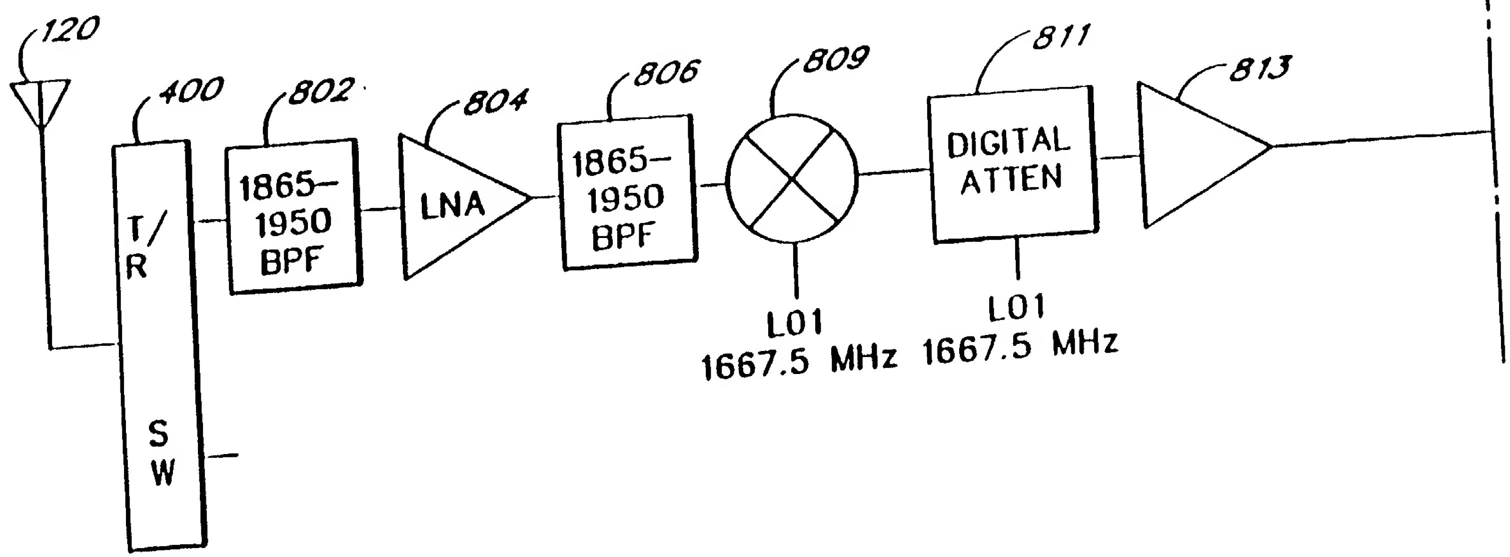


FIG. 81

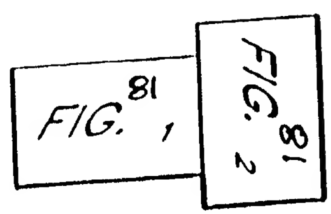


FIG. 81 2

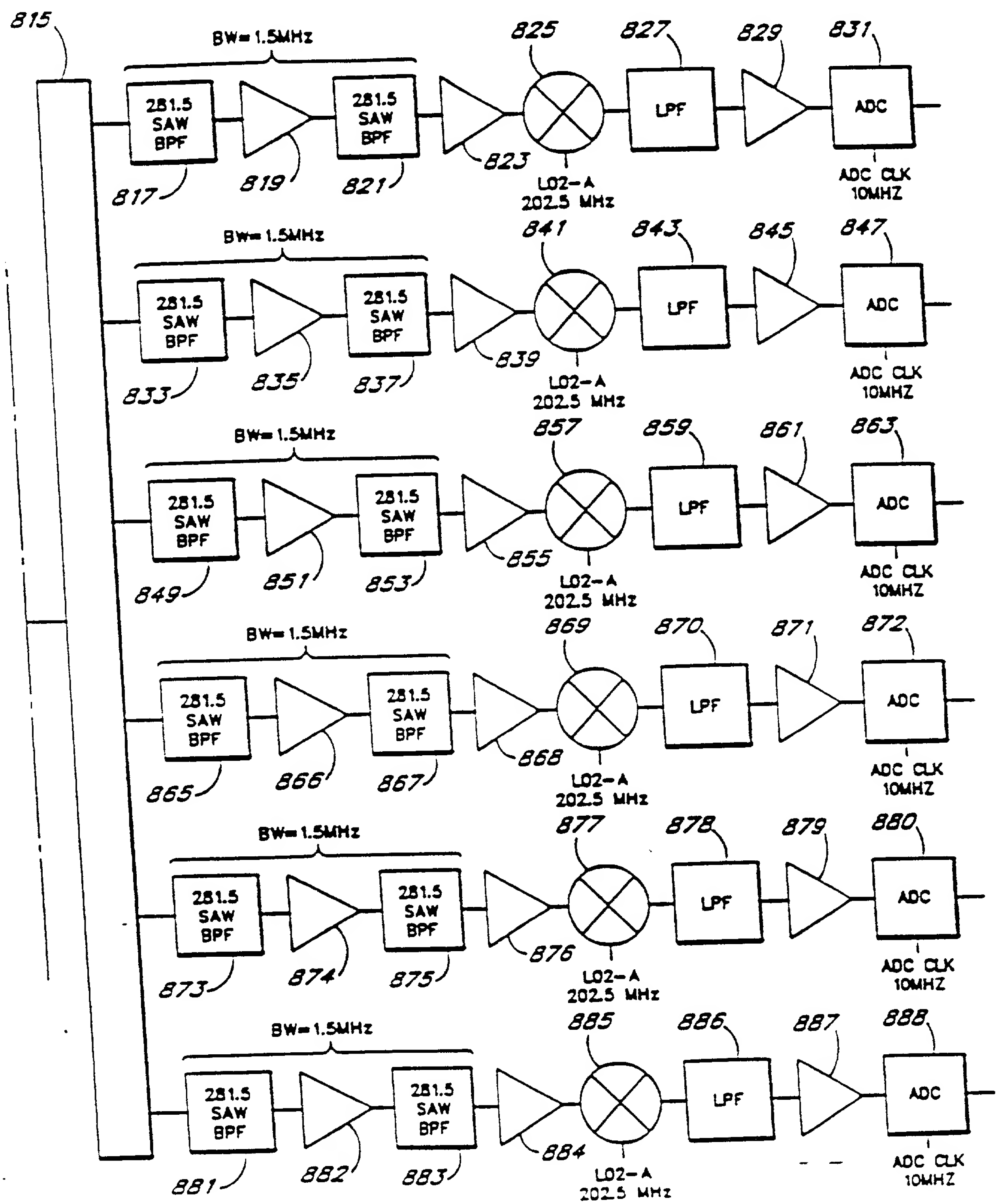
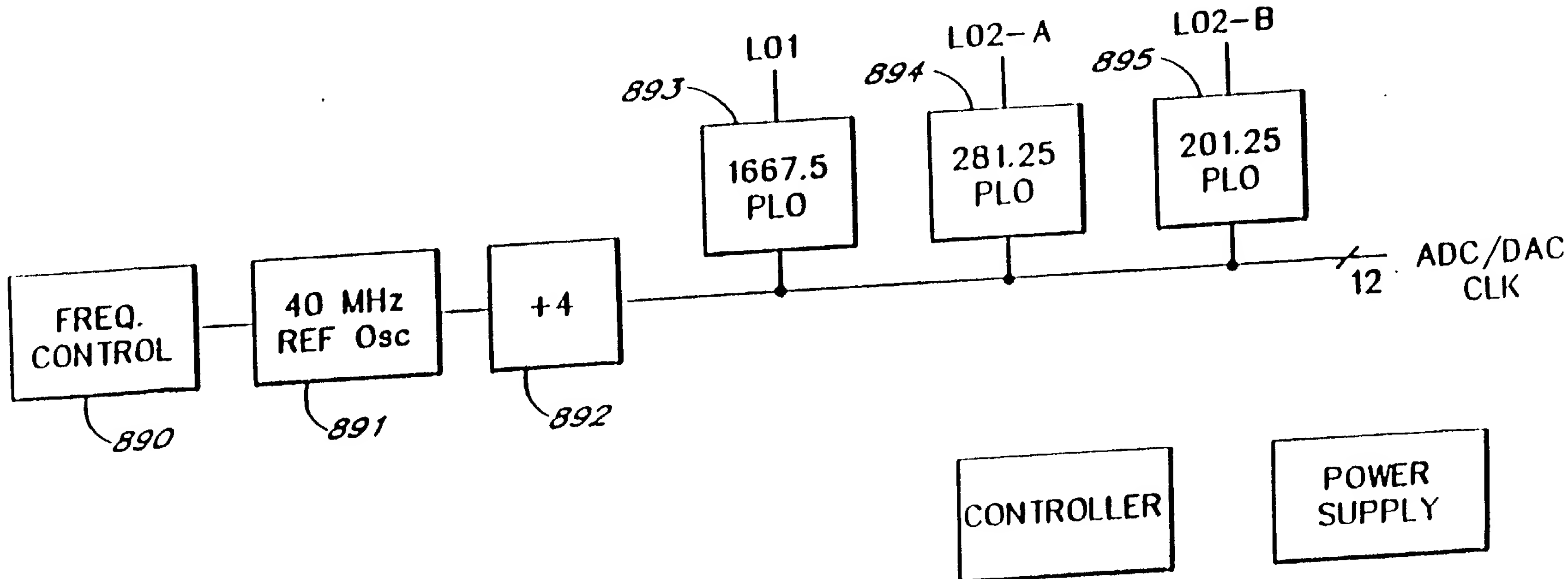

815
BW= 1.5MHz
281.5
SAW
BPF
LPF
ADC
ADC CLK
10MHZ
LO2-A
202.5 MHz
817
819
821
823
825
827
829
831
833
835
837
839
841
843
845
847
849
851
853
855
857
859
861
863
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888

FIG. 81A



L01
L02– A
L02– B
893
894
895
1667.5
PLO
281.25
PLO
201.25
PLO
12
ADC/DAC
CLK
FREQ.
CONTROL
40 MHz
REF Osc
+4
890
891
892
CONTROLLER
POWER
SUPPLY

FIG. 82 1

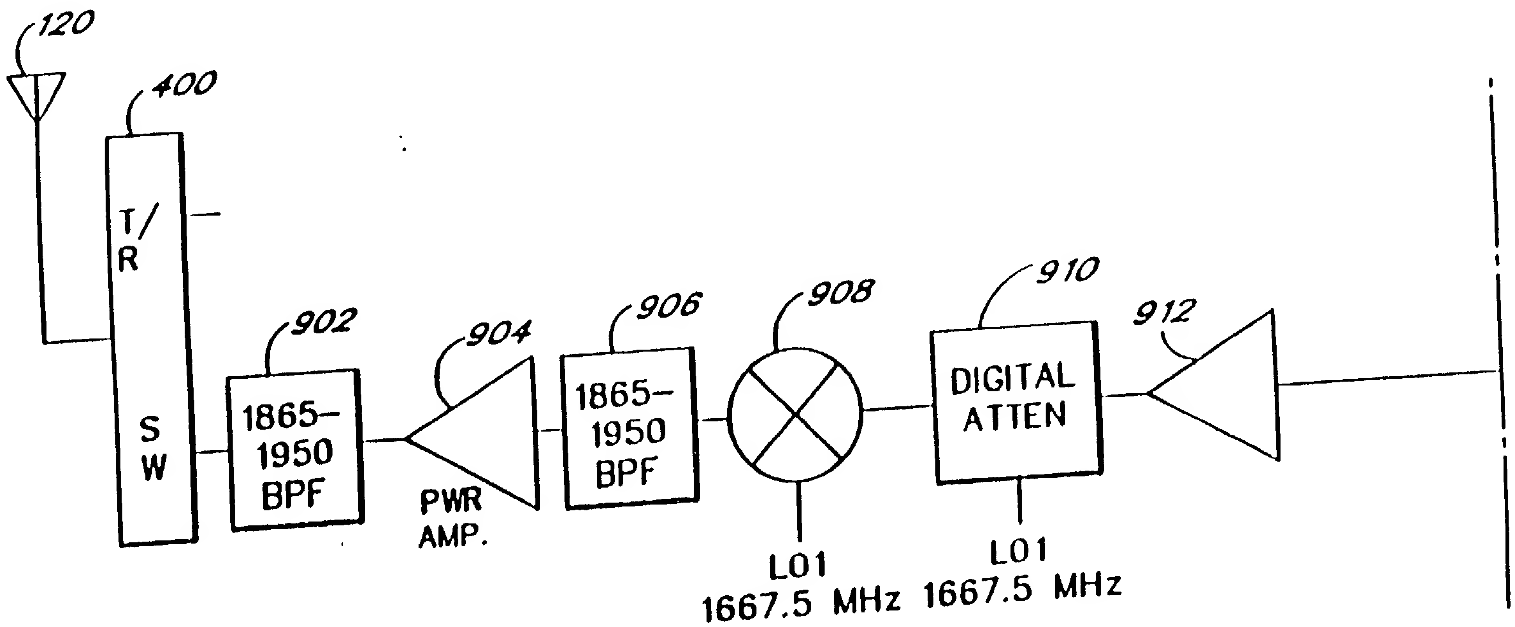


FIG. 82

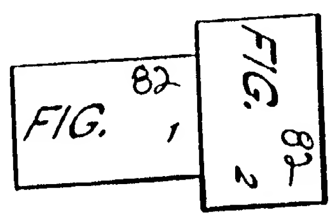
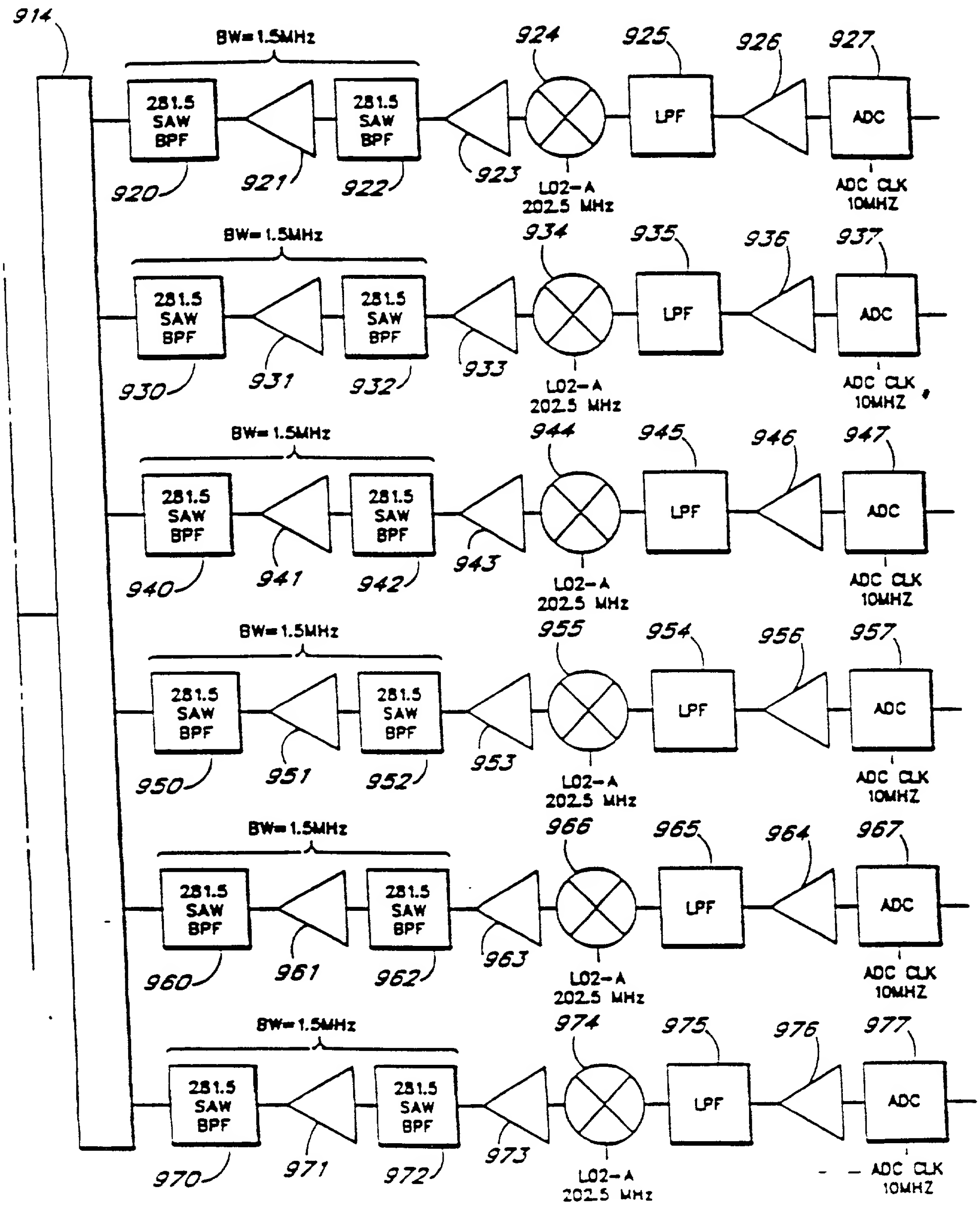


FIG. 82 2



914
BW=1.5MHz
281.5 SAW BPF
LPF
ADC
L02-A 202.5 MHz
ADC CLK 10MHZ
920 921 922 923 924 925 926 927
930 931 932 933 934 935 936 937
940 941 942 943 944 945 946 947
950 951 952 953 955 954 956 957
960 961 962 963 966 965 964 967
970 971 972 973 974 975 976 977

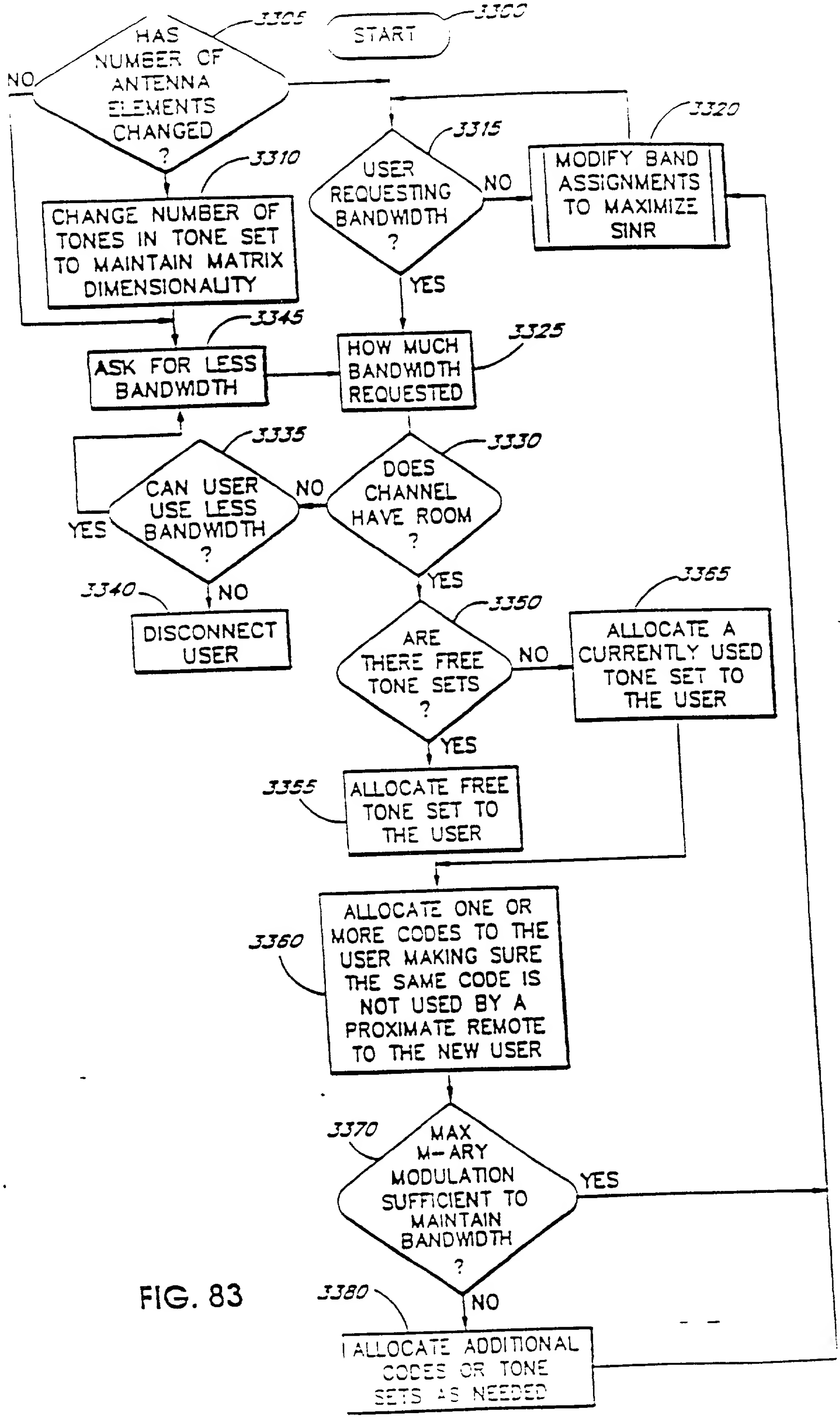
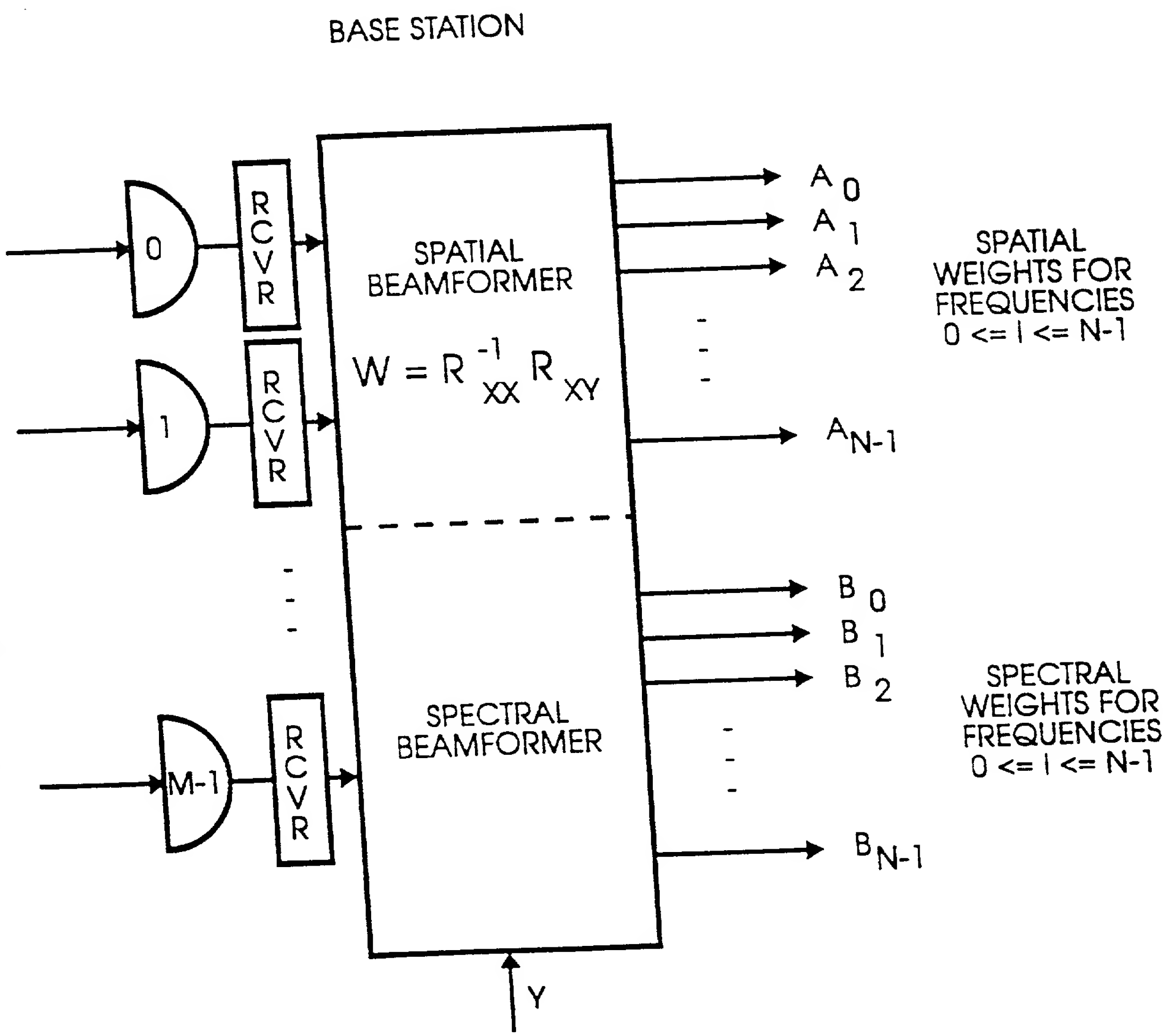

START
3300
HAS NUMBER OF ANTENNA ELEMENTS CHANGED ?
3305
NO
CHANGE NUMBER OF TONES IN TONE SET TO MAINTAIN MATRIX DIMENSIONALITY
3310
USER REQUESTING BANDWIDTH ?
3315
NO
YES
MODIFY BAND ASSIGNMENTS TO MAXIMIZE SINR
3320
ASK FOR LESS BANDWIDTH
3345
HOW MUCH BANDWIDTH REQUESTED
3325
CAN USER USE LESS BANDWIDTH ?
3335
YES
NO
DOES CHANNEL HAVE ROOM ?
3330
NO
YES
DISCONNECT USER
3340
ARE THERE FREE TONE SETS ?
3350
NO
YES
ALLOCATE A CURRENTLY USED TONE SET TO THE USER
3365
ALLOCATE FREE TONE SET TO THE USER
3355
ALLOCATE ONE OR MORE CODES TO THE USER MAKING SURE THE SAME CODE IS NOT USED BY A PROXIMATE REMOTE TO THE NEW USER
3360
MAX M-ARY MODULATION SUFFICIENT TO MAINTAIN BANDWIDTH ?
3370
YES
NO
ALLOCATE ADDITIONAL CODES OR TONE SETS AS NEEDED
3380

FIG. 83

FIG. 84A


BASE STATION
0
1
M-1
RCVR
RCVR
RCVR
SPATIAL BEAMFORMER
$W = R_{XX}^{-1} R_{XY}$
SPECTRAL BEAMFORMER
Y
A_0
A_1
A_2
A_{N-1}
SPATIAL WEIGHTS FOR FREQUENCIES
0 <= I <= N-1
B_0
B_1
B_2
B_{N-1}
SPECTRAL WEIGHTS FOR FREQUENCIES
0 <= I <= N-1

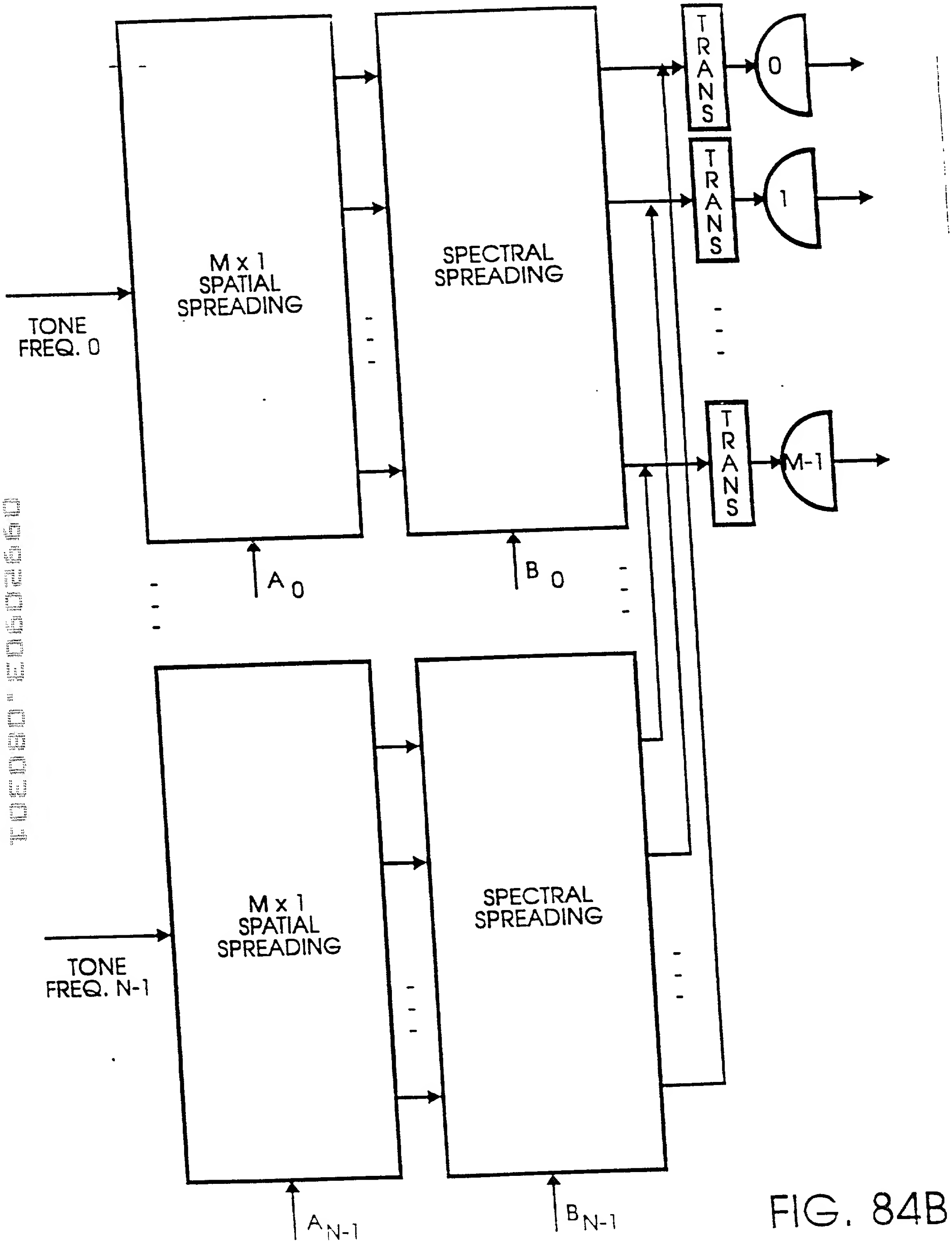
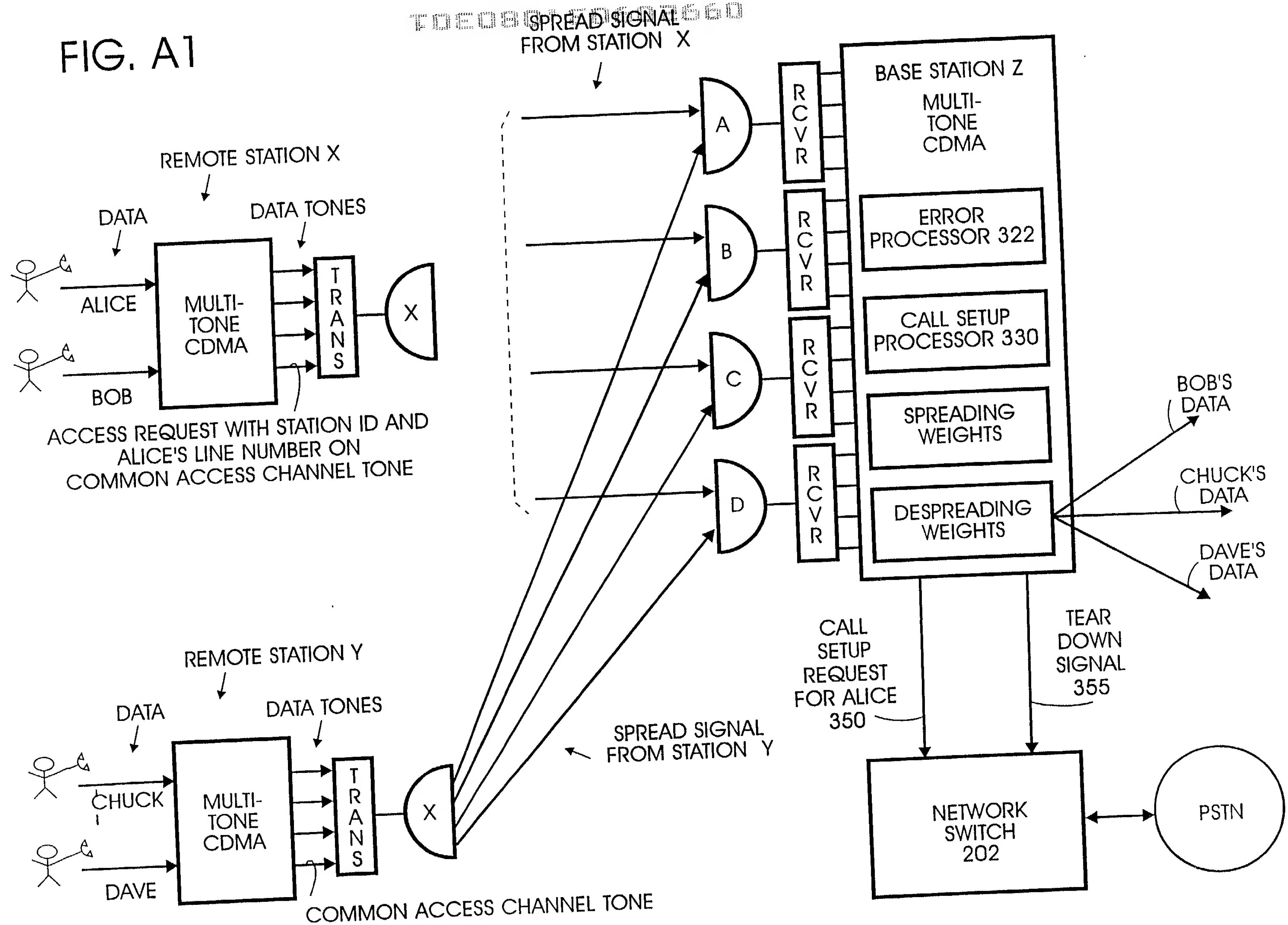

TONE FREQ. 0
M x 1 SPATIAL SPREADING
SPECTRAL SPREADING
A_0
B_0
TRANS
TRANS
TRANS
0
1
M-1
TONE FREQ. N-1
M x 1 SPATIAL SPREADING
SPECTRAL SPREADING
A_{N-1}
B_{N-1}

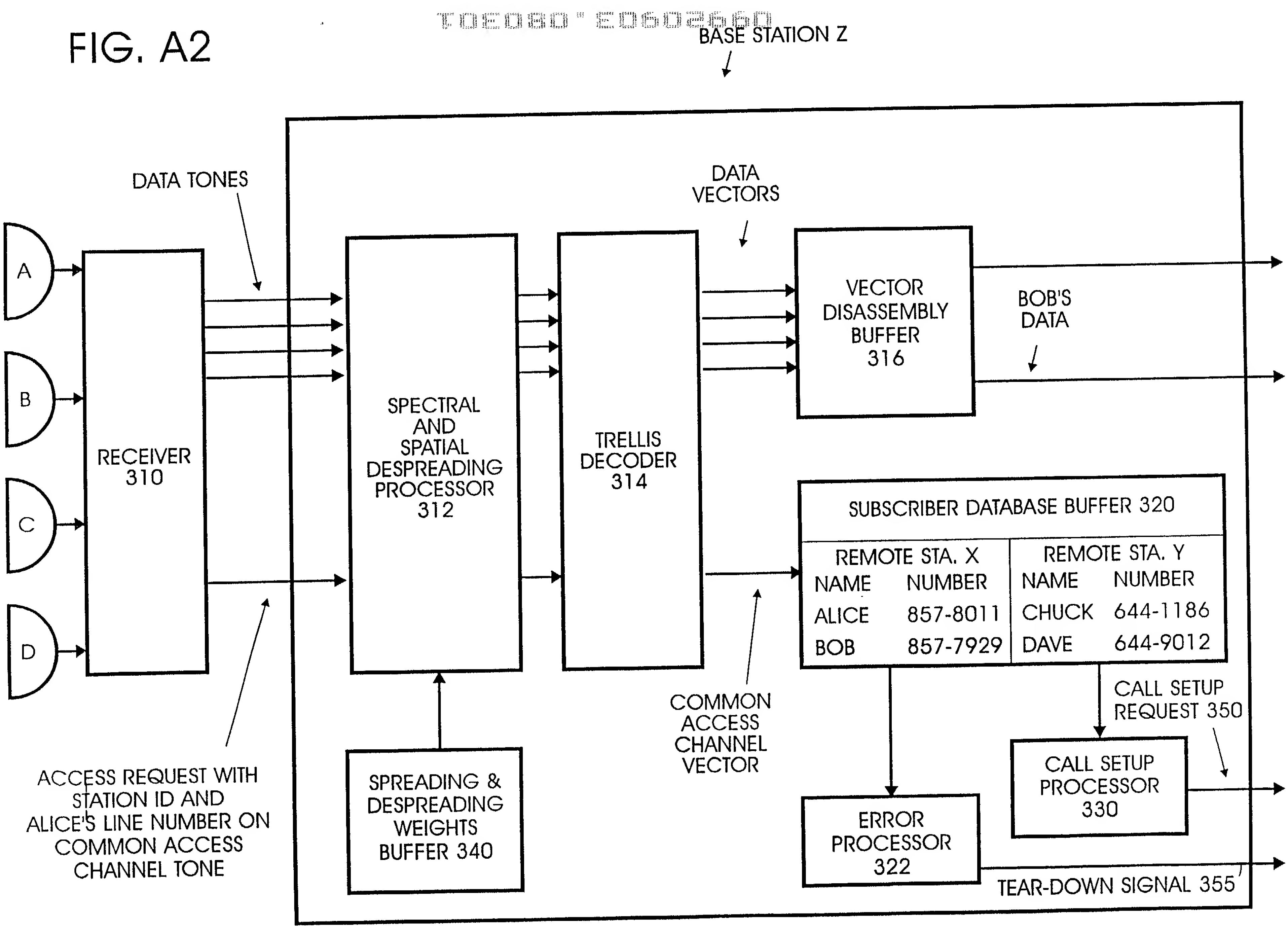
FIG. 84B

FIG. A1



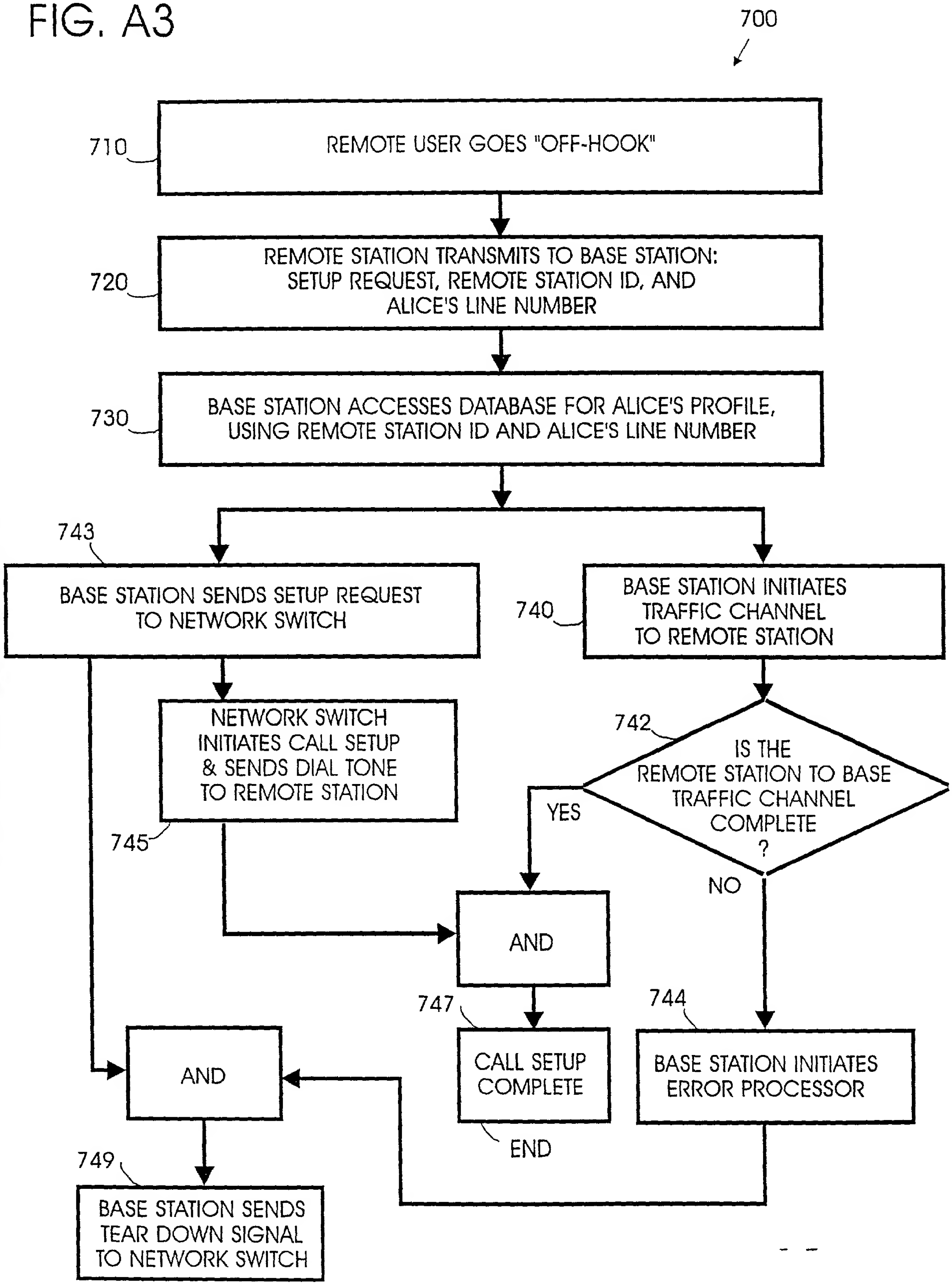
SPREAD SIGNAL FROM STATION X
REMOTE STATION X
DATA
DATA TONES
ALICE
BOB
MULTI-TONE CDMA
TRANS
X
ACCESS REQUEST WITH STATION ID AND ALICE'S LINE NUMBER ON COMMON ACCESS CHANNEL TONE
A
B
C
D
RCVR
RCVR
RCVR
RCVR
BASE STATION Z
MULTI-TONE CDMA
ERROR PROCESSOR 322
CALL SETUP PROCESSOR 330
SPREADING WEIGHTS
DESPREADING WEIGHTS
BOB'S DATA
CHUCK'S DATA
DAVE'S DATA
CALL SETUP REQUEST FOR ALICE 350
TEAR DOWN SIGNAL 355
NETWORK SWITCH 202
PSTN
REMOTE STATION Y
DATA
DATA TONES
CHUCK
DAVE
MULTI-TONE CDMA
TRANS
X
SPREAD SIGNAL FROM STATION Y
COMMON ACCESS CHANNEL TONE

FIG. A2



BASE STATION Z
DATA TONES
A
B
C
D
RECEIVER 310
SPECTRAL AND SPATIAL DESPREADING PROCESSOR 312
TRELLIS DECODER 314
DATA VECTORS
VECTOR DISASSEMBLY BUFFER 316
BOB'S DATA
SUBSCRIBER DATABASE BUFFER 320
REMOTE STA. X
NAME NUMBER
ALICE 857-8011
BOB 857-7929
REMOTE STA. Y
NAME NUMBER
CHUCK 644-1186
DAVE 644-9012
CALL SETUP REQUEST 350
CALL SETUP PROCESSOR 330
ERROR PROCESSOR 322
TEAR-DOWN SIGNAL 355
COMMON ACCESS CHANNEL VECTOR
SPREADING & DESPREADING WEIGHTS BUFFER 340
ACCESS REQUEST WITH STATION ID AND ALICE'S LINE NUMBER ON COMMON ACCESS CHANNEL TONE

FIG. A3



700
710
REMOTE USER GOES "OFF-HOOK"
720
REMOTE STATION TRANSMITS TO BASE STATION: SETUP REQUEST, REMOTE STATION ID, AND ALICE'S LINE NUMBER
730
BASE STATION ACCESSES DATABASE FOR ALICE'S PROFILE, USING REMOTE STATION ID AND ALICE'S LINE NUMBER
743
BASE STATION SENDS SETUP REQUEST TO NETWORK SWITCH
740
BASE STATION INITIATES TRAFFIC CHANNEL TO REMOTE STATION
NETWORK SWITCH INITIATES CALL SETUP & SENDS DIAL TONE TO REMOTE STATION
745
742
IS THE REMOTE STATION TO BASE TRAFFIC CHANNEL COMPLETE ?
YES
NO
AND
747
744
AND
CALL SETUP COMPLETE
BASE STATION INITIATES ERROR PROCESSOR
END
749
BASE STATION SENDS TEAR DOWN SIGNAL TO NETWORK SWITCH

FIG. B1

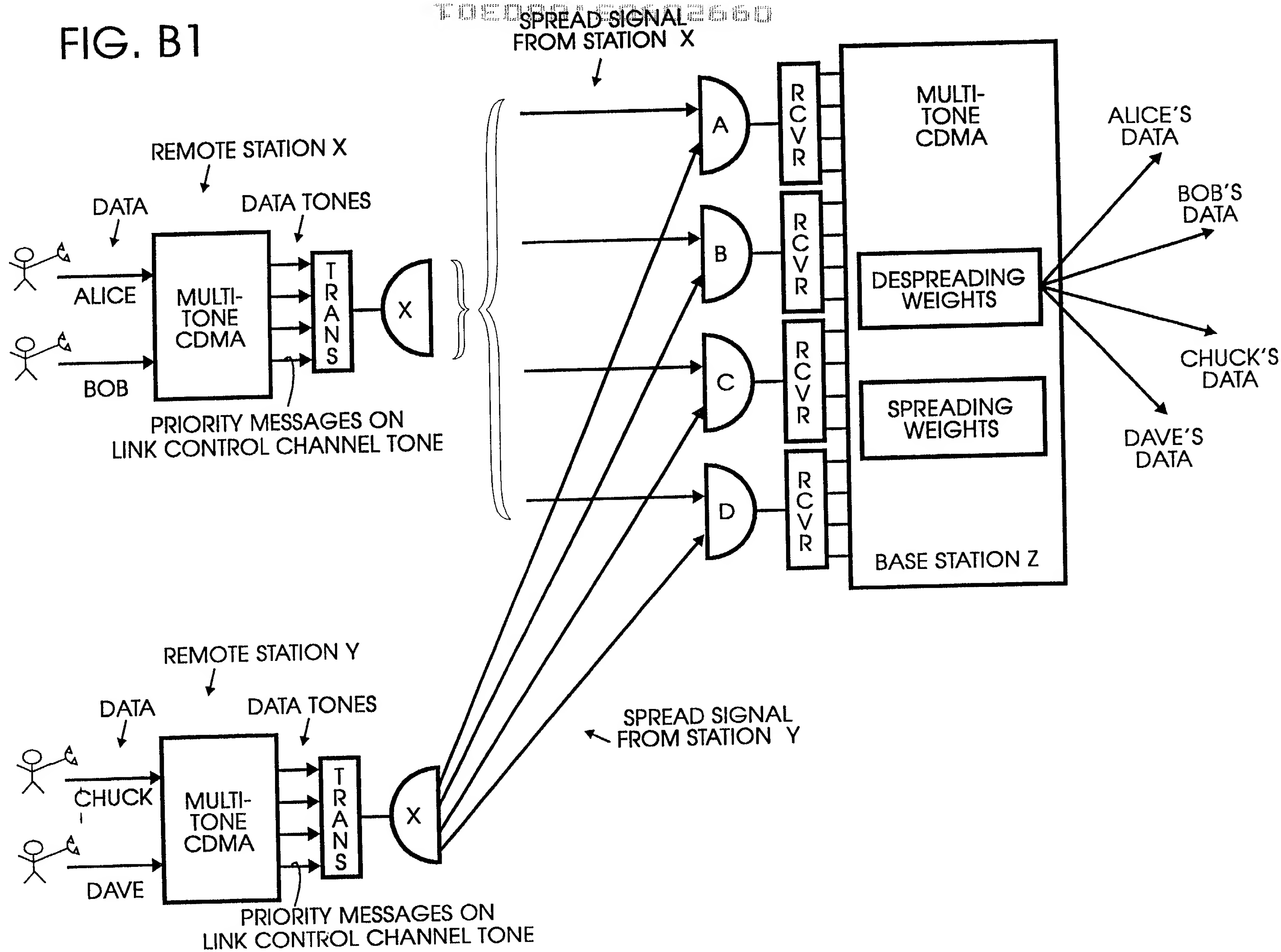
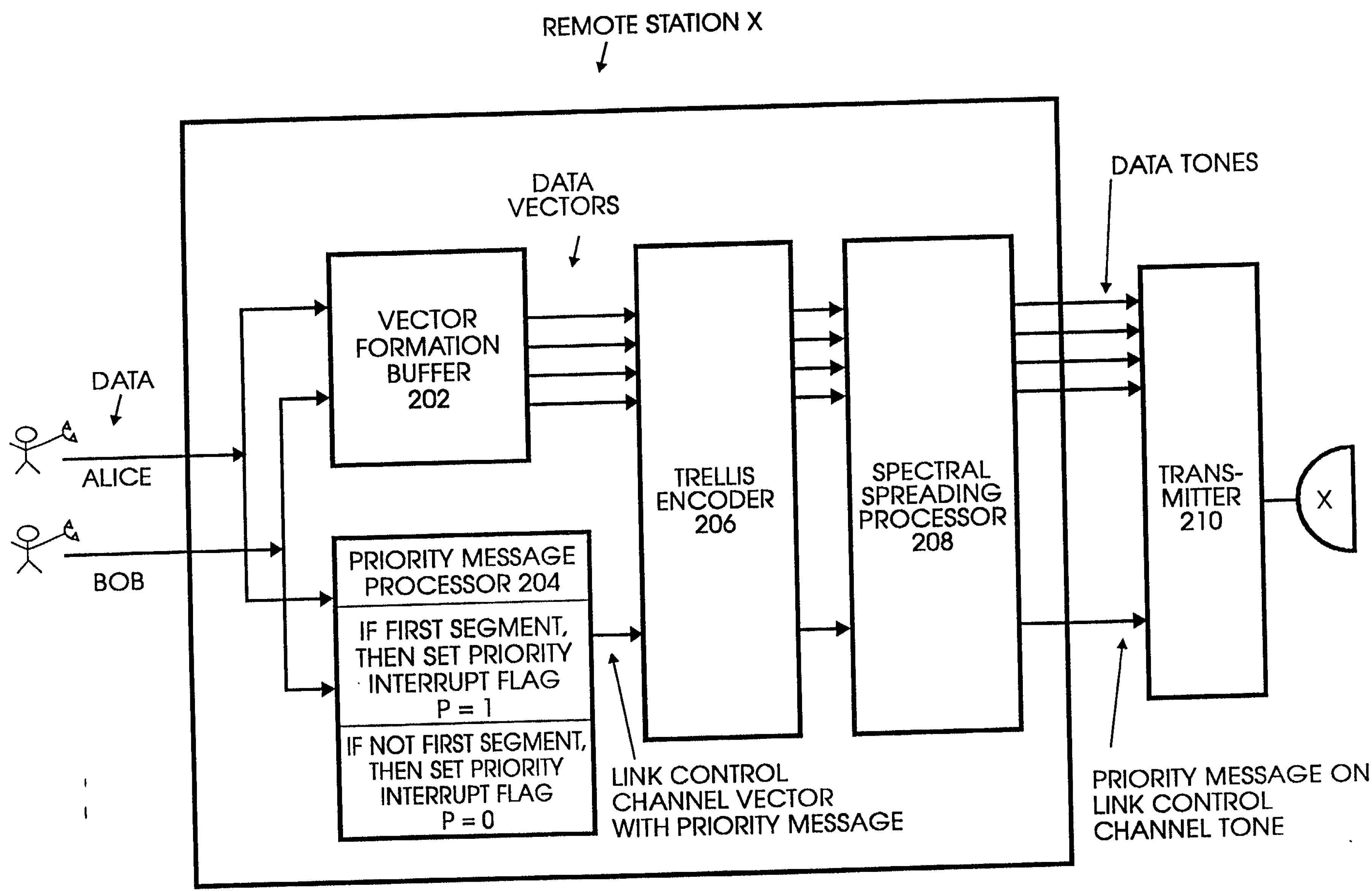

REMOTE STATION X
DATA
DATA TONES
ALICE
BOB
MULTI-
TONE
CDMA
TRANS
X
PRIORITY MESSAGES ON
LINK CONTROL CHANNEL TONE
SPREAD SIGNAL
FROM STATION X
A
B
C
D
RCVR
RCVR
RCVR
RCVR
MULTI-
TONE
CDMA
DESPREADING
WEIGHTS
SPREADING
WEIGHTS
BASE STATION Z
ALICE'S
DATA
BOB'S
DATA
CHUCK'S
DATA
DAVE'S
DATA
REMOTE STATION Y
DATA
DATA TONES
CHUCK
DAVE
MULTI-
TONE
CDMA
TRANS
X
PRIORITY MESSAGES ON
LINK CONTROL CHANNEL TONE
SPREAD SIGNAL
FROM STATION Y

FIG. B2



REMOTE STATION X
DATA
ALICE
BOB
VECTOR FORMATION BUFFER 202
DATA VECTORS
PRIORITY MESSAGE PROCESSOR 204
IF FIRST SEGMENT, THEN SET PRIORITY INTERRUPT FLAG P = 1
IF NOT FIRST SEGMENT, THEN SET PRIORITY INTERRUPT FLAG P = 0
TRELLIS ENCODER 206
LINK CONTROL CHANNEL VECTOR WITH PRIORITY MESSAGE
SPECTRAL SPREADING PROCESSOR 208
DATA TONES
TRANS-MITTER 210
X
PRIORITY MESSAGE ON LINK CONTROL CHANNEL TONE

09602303 . 080301

FIG. B3

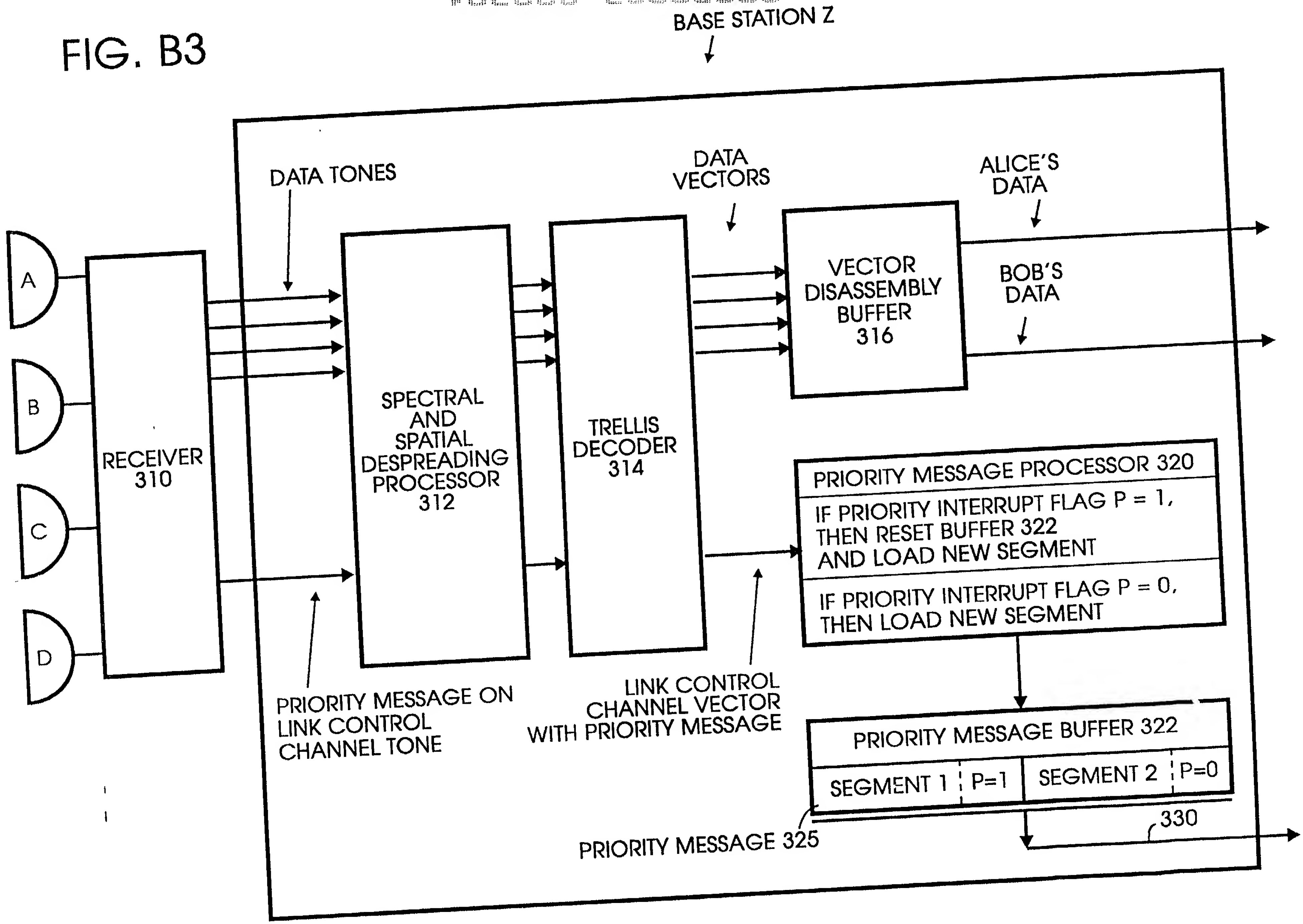
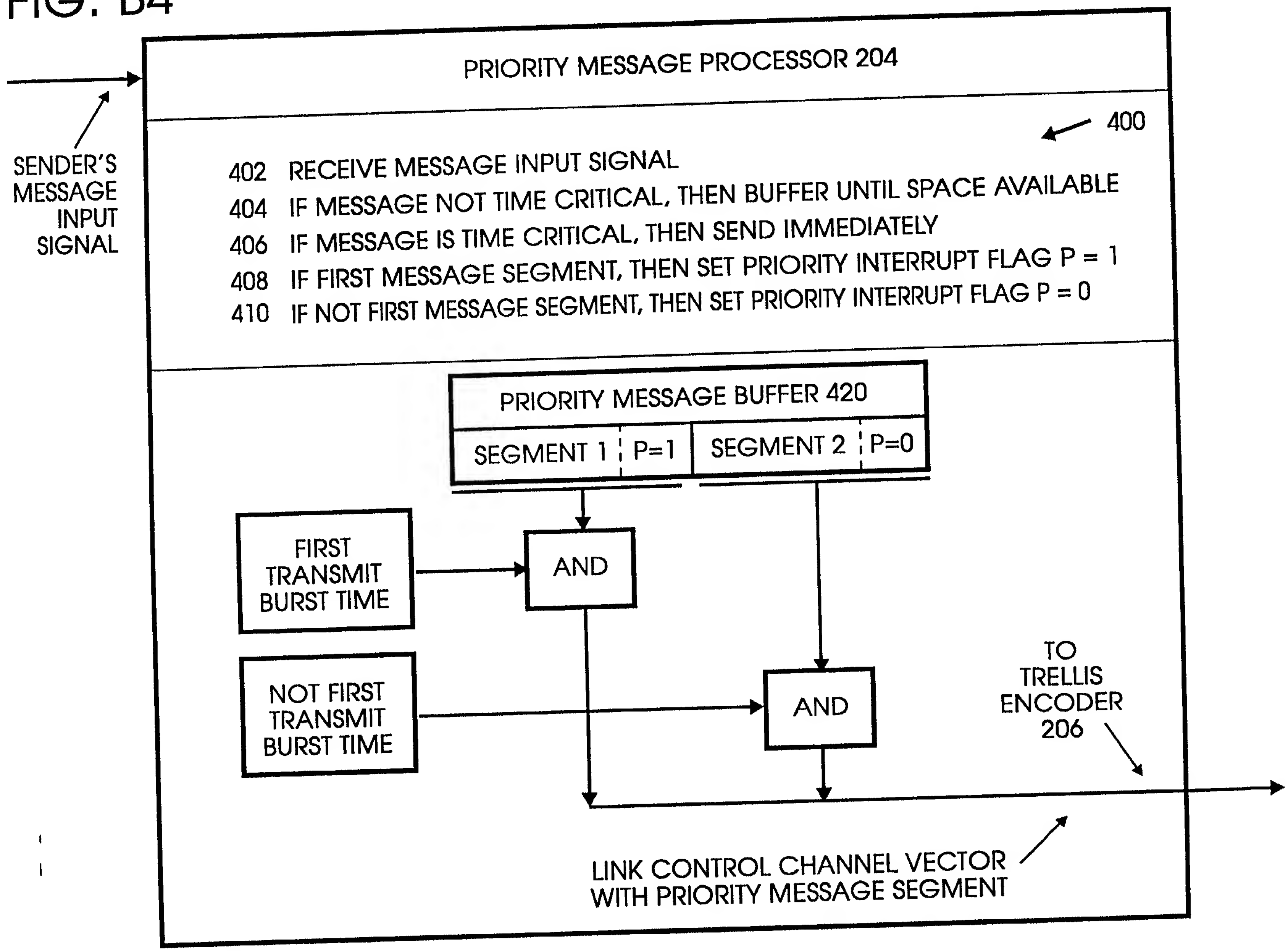


FIG. B4



SENDER'S MESSAGE INPUT SIGNAL
PRIORITY MESSAGE PROCESSOR 204
400
402 RECEIVE MESSAGE INPUT SIGNAL
404 IF MESSAGE NOT TIME CRITICAL, THEN BUFFER UNTIL SPACE AVAILABLE
406 IF MESSAGE IS TIME CRITICAL, THEN SEND IMMEDIATELY
408 IF FIRST MESSAGE SEGMENT, THEN SET PRIORITY INTERRUPT FLAG P = 1
410 IF NOT FIRST MESSAGE SEGMENT, THEN SET PRIORITY INTERRUPT FLAG P = 0
PRIORITY MESSAGE BUFFER 420
SEGMENT 1
P=1
SEGMENT 2
P=0
FIRST TRANSMIT BURST TIME
AND
NOT FIRST TRANSMIT BURST TIME
AND
TO TRELLIS ENCODER 206
LINK CONTROL CHANNEL VECTOR WITH PRIORITY MESSAGE SEGMENT

FIG. B5

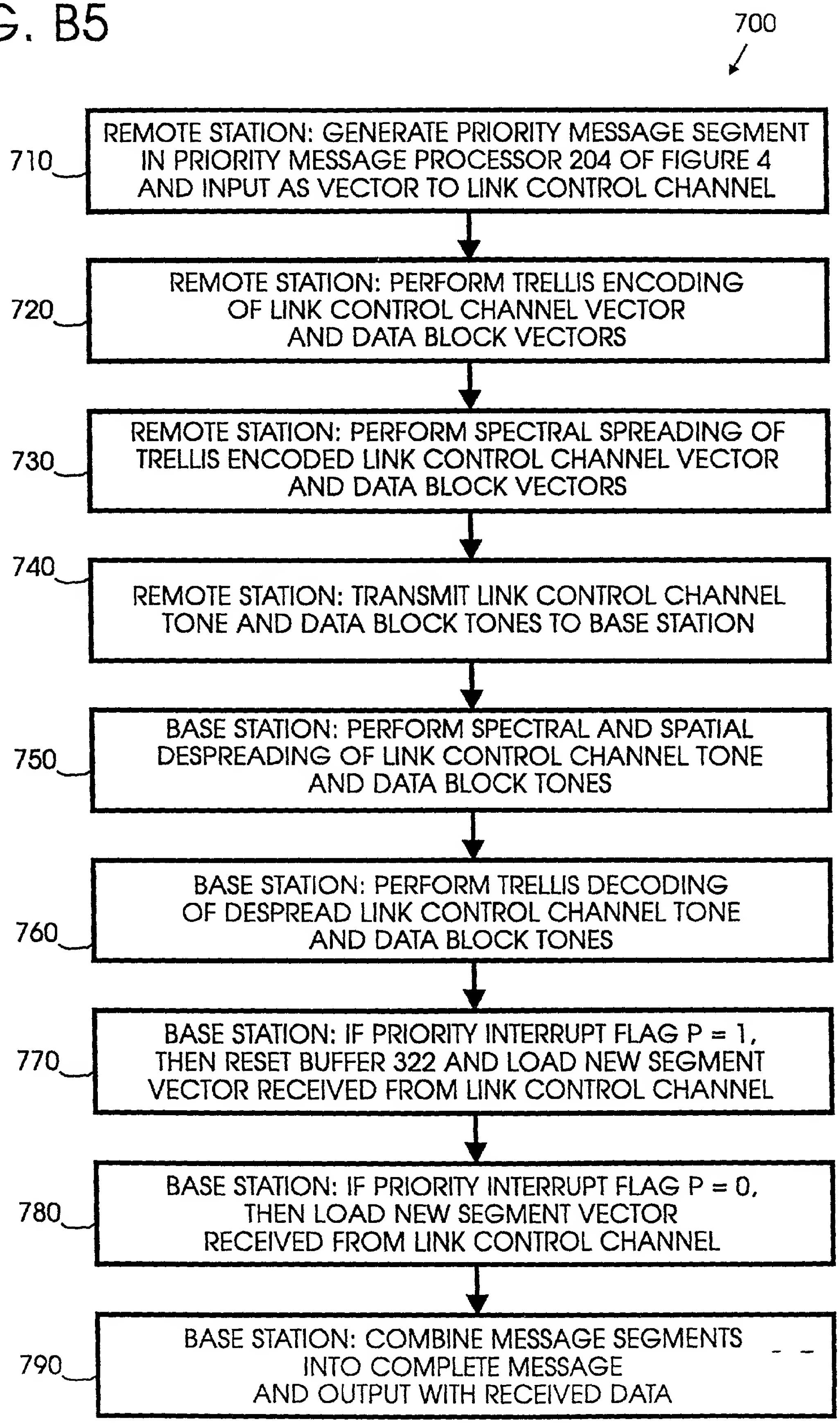
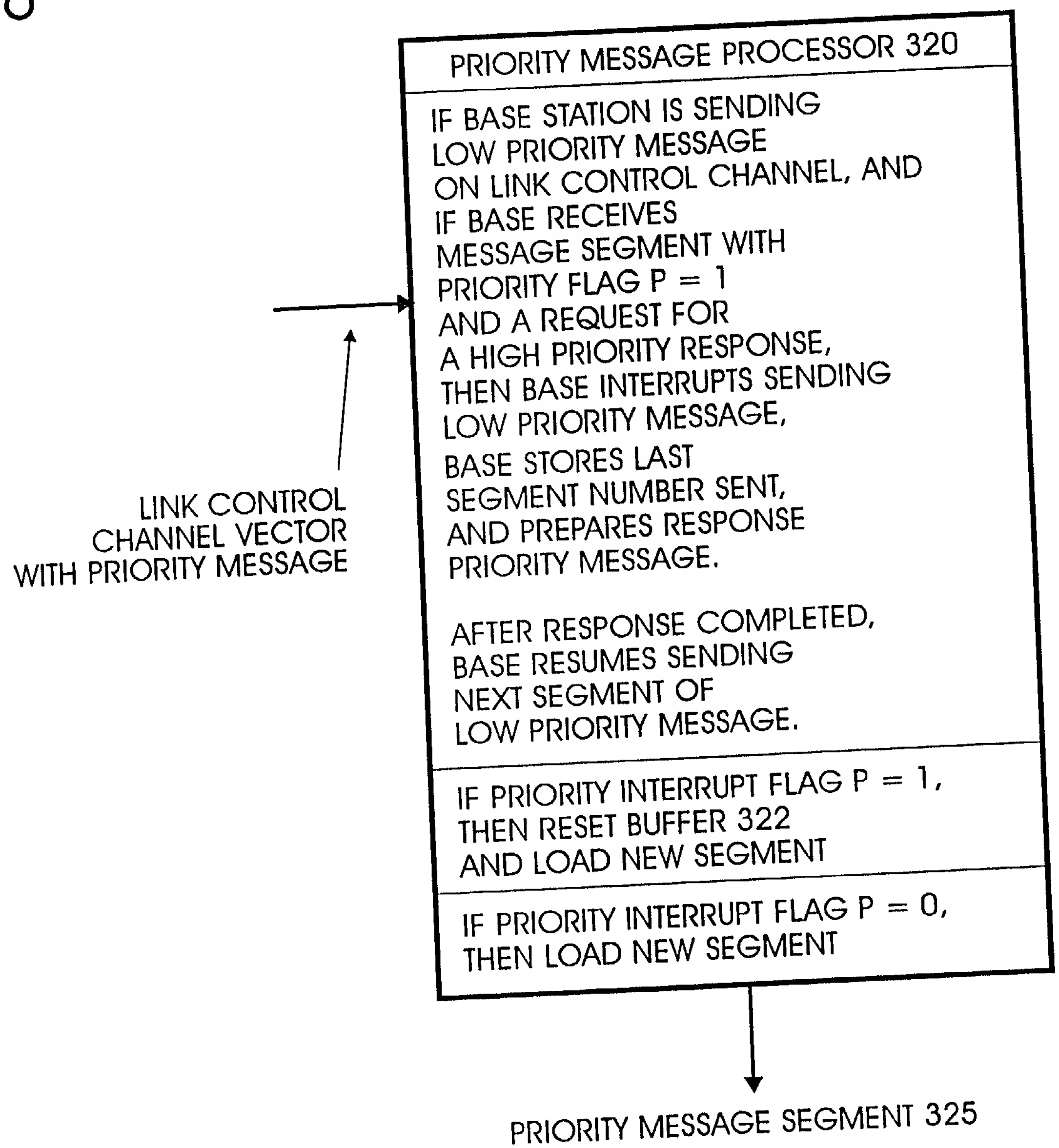

700
710
REMOTE STATION: GENERATE PRIORITY MESSAGE SEGMENT IN PRIORITY MESSAGE PROCESSOR 204 OF FIGURE 4 AND INPUT AS VECTOR TO LINK CONTROL CHANNEL
720
REMOTE STATION: PERFORM TRELLIS ENCODING OF LINK CONTROL CHANNEL VECTOR AND DATA BLOCK VECTORS
730
REMOTE STATION: PERFORM SPECTRAL SPREADING OF TRELLIS ENCODED LINK CONTROL CHANNEL VECTOR AND DATA BLOCK VECTORS
740
REMOTE STATION: TRANSMIT LINK CONTROL CHANNEL TONE AND DATA BLOCK TONES TO BASE STATION
750
BASE STATION: PERFORM SPECTRAL AND SPATIAL DESPREADING OF LINK CONTROL CHANNEL TONE AND DATA BLOCK TONES
760
BASE STATION: PERFORM TRELLIS DECODING OF DESPREAD LINK CONTROL CHANNEL TONE AND DATA BLOCK TONES
770
BASE STATION: IF PRIORITY INTERRUPT FLAG P = 1, THEN RESET BUFFER 322 AND LOAD NEW SEGMENT VECTOR RECEIVED FROM LINK CONTROL CHANNEL
780
BASE STATION: IF PRIORITY INTERRUPT FLAG P = 0, THEN LOAD NEW SEGMENT VECTOR RECEIVED FROM LINK CONTROL CHANNEL
790
BASE STATION: COMBINE MESSAGE SEGMENTS INTO COMPLETE MESSAGE AND OUTPUT WITH RECEIVED DATA

FIG. B6



LINK CONTROL
CHANNEL VECTOR
WITH PRIORITY MESSAGE
PRIORITY MESSAGE PROCESSOR 320
IF BASE STATION IS SENDING
LOW PRIORITY MESSAGE
ON LINK CONTROL CHANNEL, AND
IF BASE RECEIVES
MESSAGE SEGMENT WITH
PRIORITY FLAG P = 1
AND A REQUEST FOR
A HIGH PRIORITY RESPONSE,
THEN BASE INTERRUPTS SENDING
LOW PRIORITY MESSAGE,
BASE STORES LAST
SEGMENT NUMBER SENT,
AND PREPARES RESPONSE
PRIORITY MESSAGE.
AFTER RESPONSE COMPLETED,
BASE RESUMES SENDING
NEXT SEGMENT OF
LOW PRIORITY MESSAGE.
IF PRIORITY INTERRUPT FLAG P = 1,
THEN RESET BUFFER 322
AND LOAD NEW SEGMENT
IF PRIORITY INTERRUPT FLAG P = 0,
THEN LOAD NEW SEGMENT
PRIORITY MESSAGE SEGMENT 325

FIG. C1A

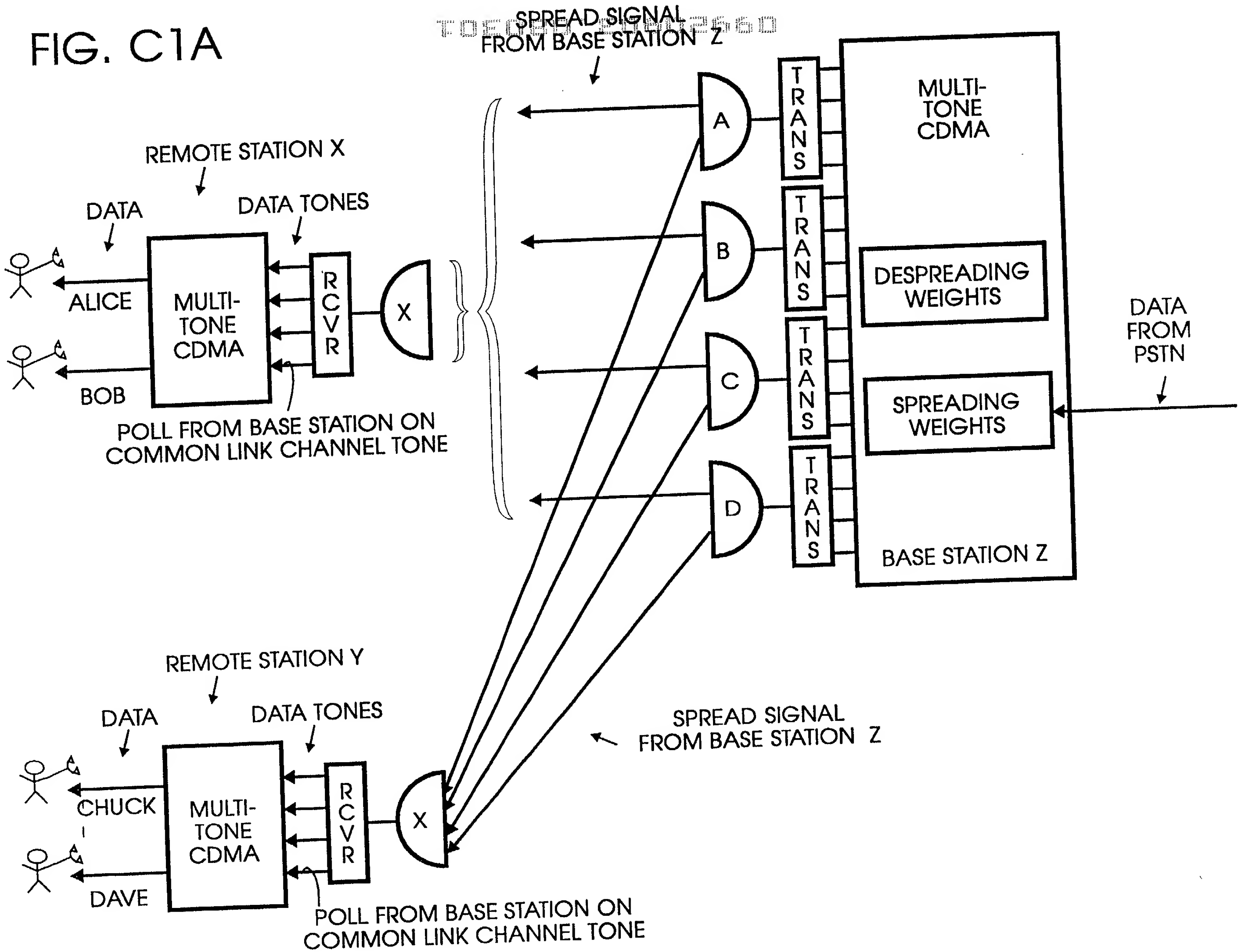

SPREAD SIGNAL
FROM BASE STATION Z
REMOTE STATION X
DATA
DATA TONES
ALICE
BOB
MULTI-
TONE
CDMA
RCVR
X
POLL FROM BASE STATION ON
COMMON LINK CHANNEL TONE
A
B
C
D
TRANS
TRANS
TRANS
TRANS
MULTI-
TONE
CDMA
DESPREADING
WEIGHTS
SPREADING
WEIGHTS
BASE STATION Z
DATA
FROM
PSTN
REMOTE STATION Y
DATA
DATA TONES
CHUCK
DAVE
MULTI-
TONE
CDMA
RCVR
X
SPREAD SIGNAL
FROM BASE STATION Z
POLL FROM BASE STATION ON
COMMON LINK CHANNEL TONE

FIG. C1B

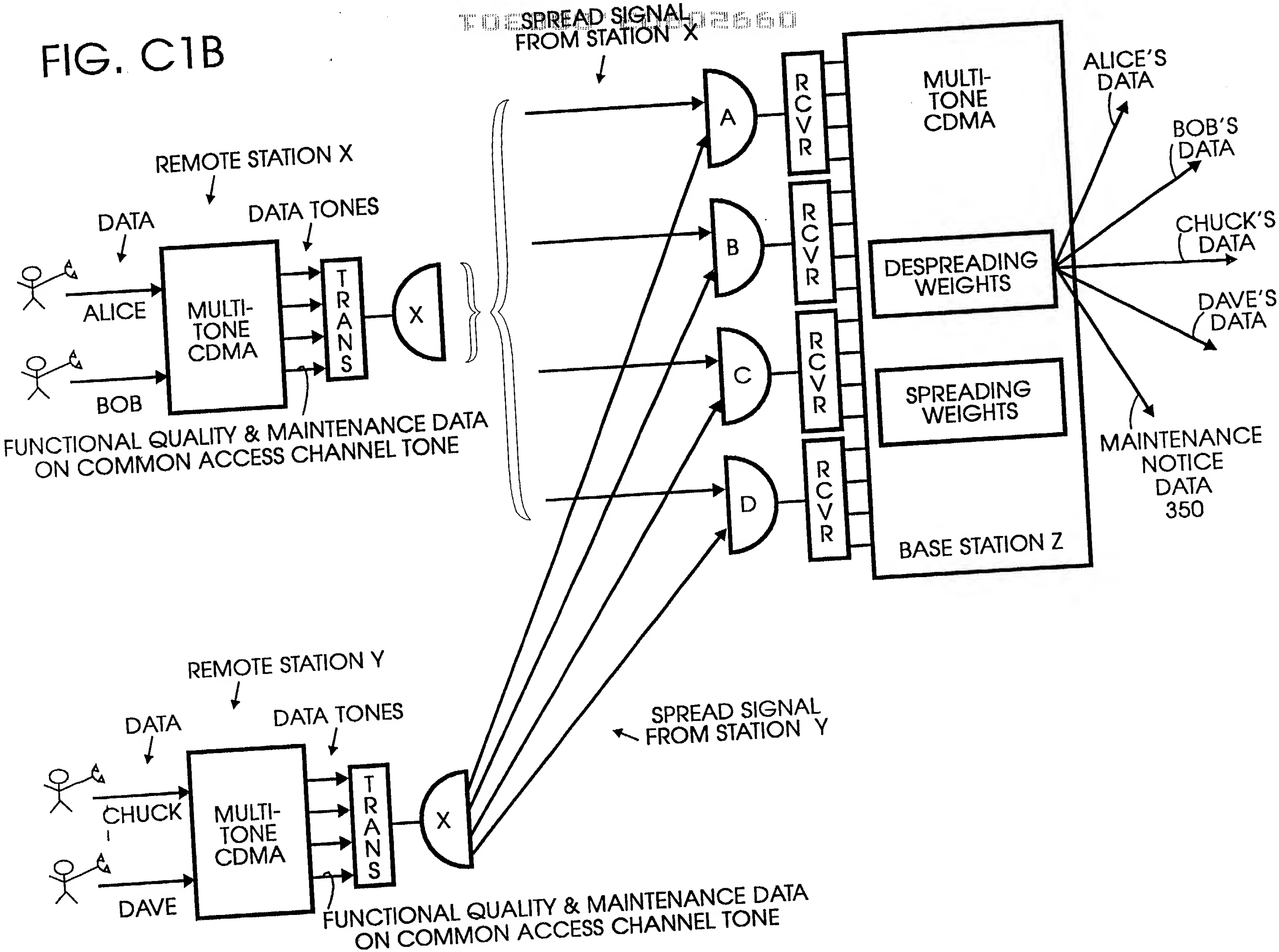

SPREAD SIGNAL FROM STATION X
REMOTE STATION X
DATA
DATA TONES
ALICE
BOB
MULTI-TONE CDMA
TRANS
X
FUNCTIONAL QUALITY & MAINTENANCE DATA ON COMMON ACCESS CHANNEL TONE
A
B
C
D
RCVR
RCVR
RCVR
RCVR
MULTI-TONE CDMA
DESPREADING WEIGHTS
SPREADING WEIGHTS
BASE STATION Z
ALICE'S DATA
BOB'S DATA
CHUCK'S DATA
DAVE'S DATA
MAINTENANCE NOTICE DATA 350
REMOTE STATION Y
DATA
DATA TONES
CHUCK
DAVE
MULTI-TONE CDMA
TRANS
X
SPREAD SIGNAL FROM STATION Y
FUNCTIONAL QUALITY & MAINTENANCE DATA ON COMMON ACCESS CHANNEL TONE

FIG. C2

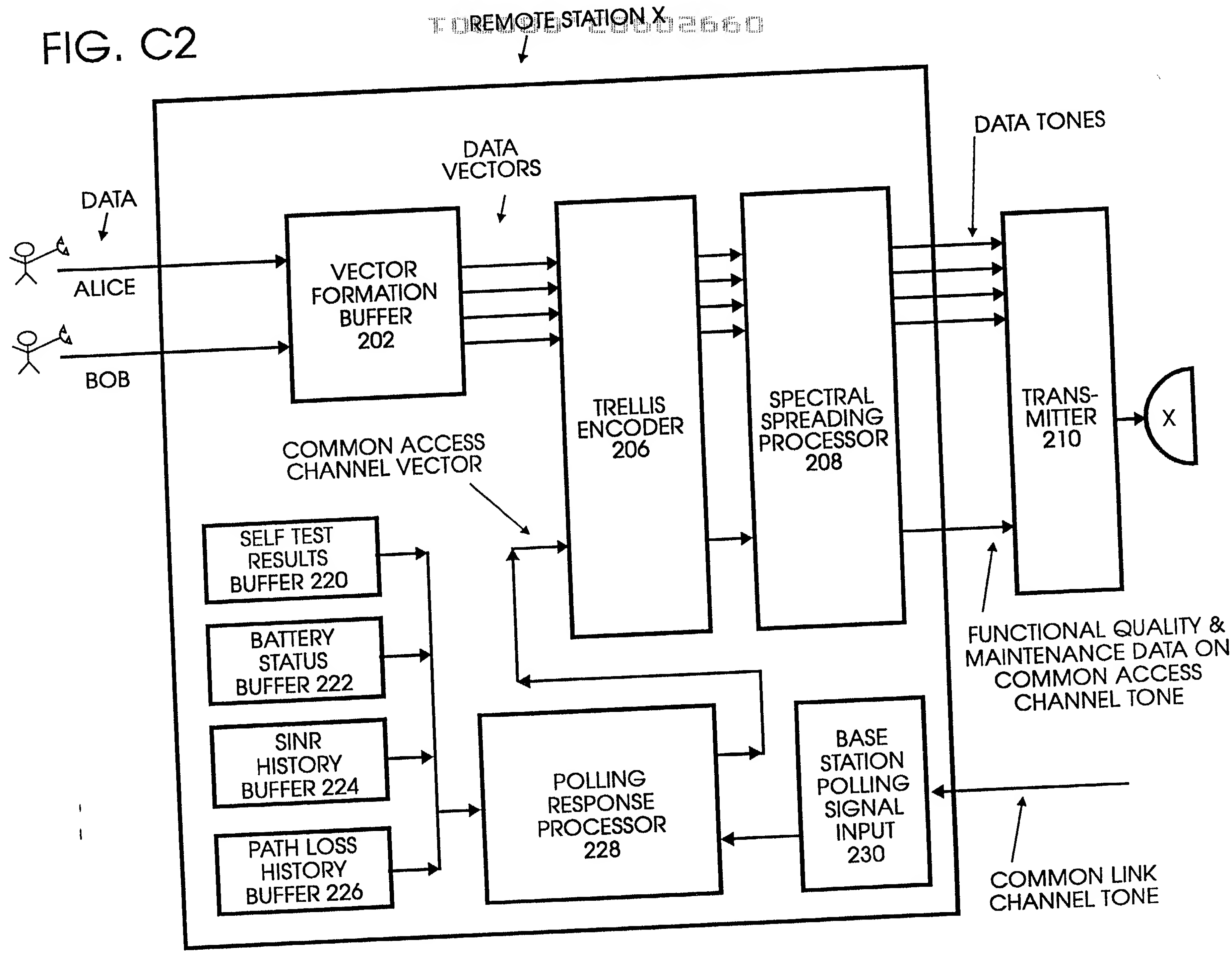
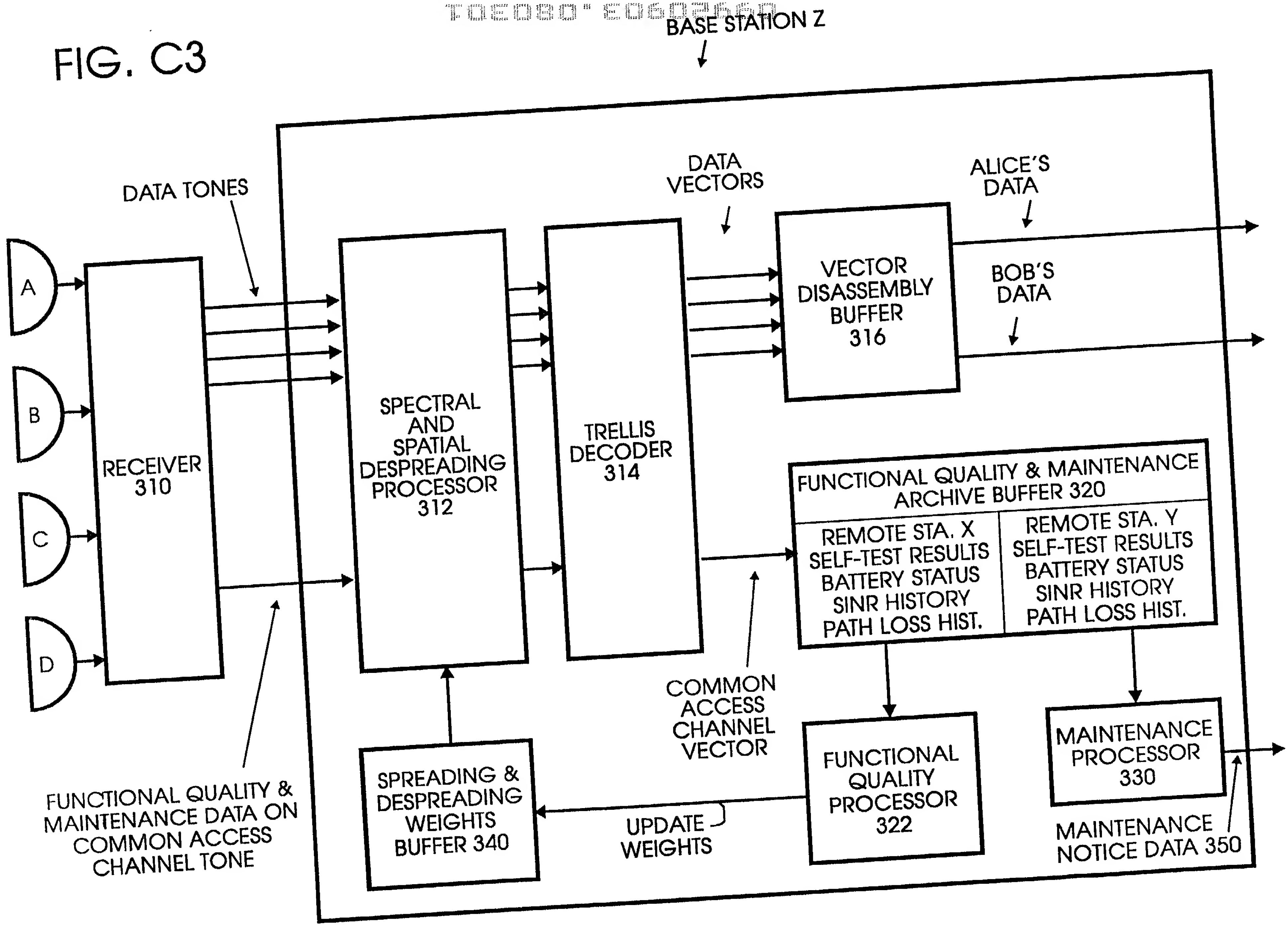
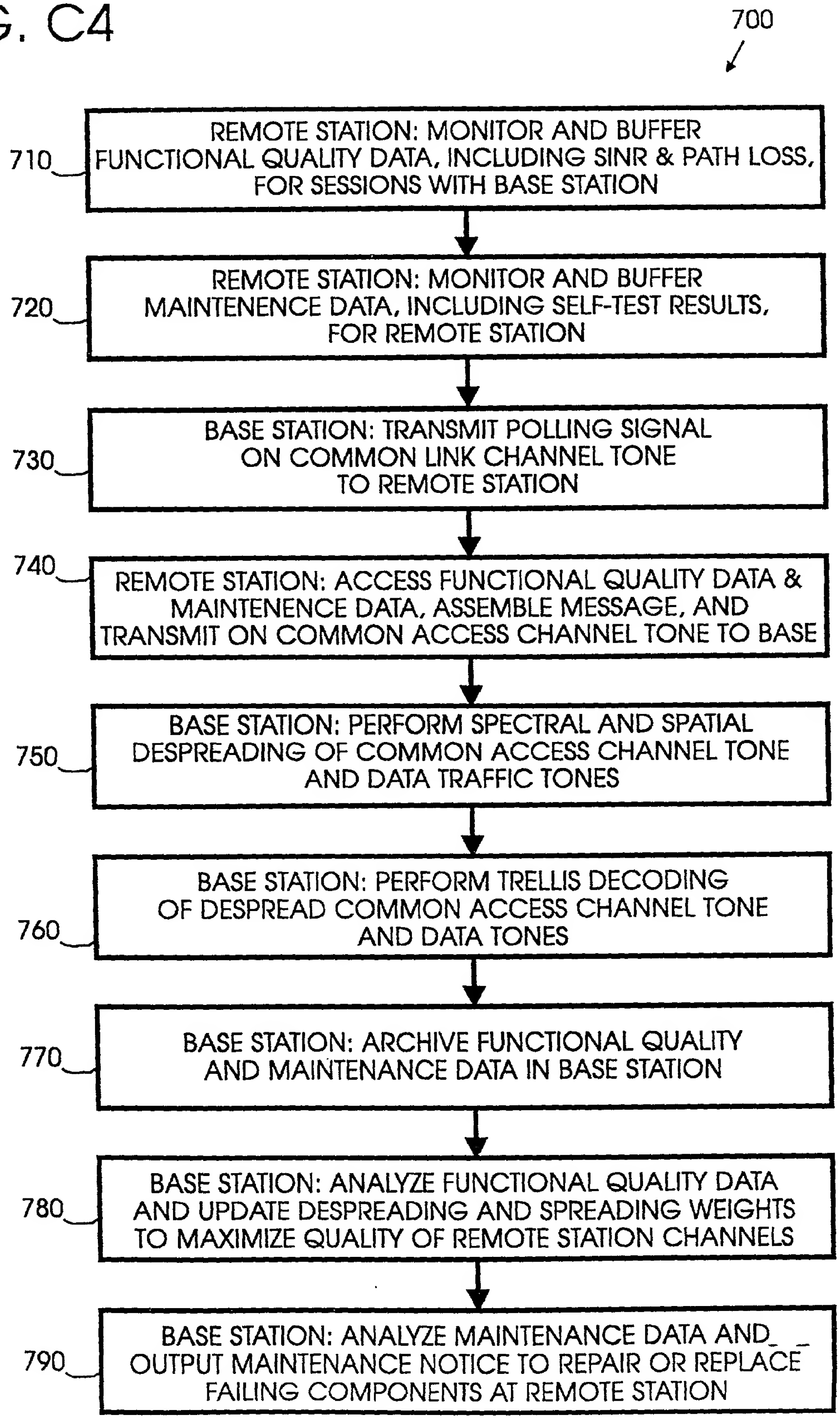

REMOTE STATION X
DATA
ALICE
BOB
DATA VECTORS
VECTOR FORMATION BUFFER 202
TRELLIS ENCODER 206
SPECTRAL SPREADING PROCESSOR 208
DATA TONES
TRANS-MITTER 210
X
COMMON ACCESS CHANNEL VECTOR
SELF TEST RESULTS BUFFER 220
BATTERY STATUS BUFFER 222
SINR HISTORY BUFFER 224
PATH LOSS HISTORY BUFFER 226
POLLING RESPONSE PROCESSOR 228
BASE STATION POLLING SIGNAL INPUT 230
FUNCTIONAL QUALITY & MAINTENANCE DATA ON COMMON ACCESS CHANNEL TONE
COMMON LINK CHANNEL TONE

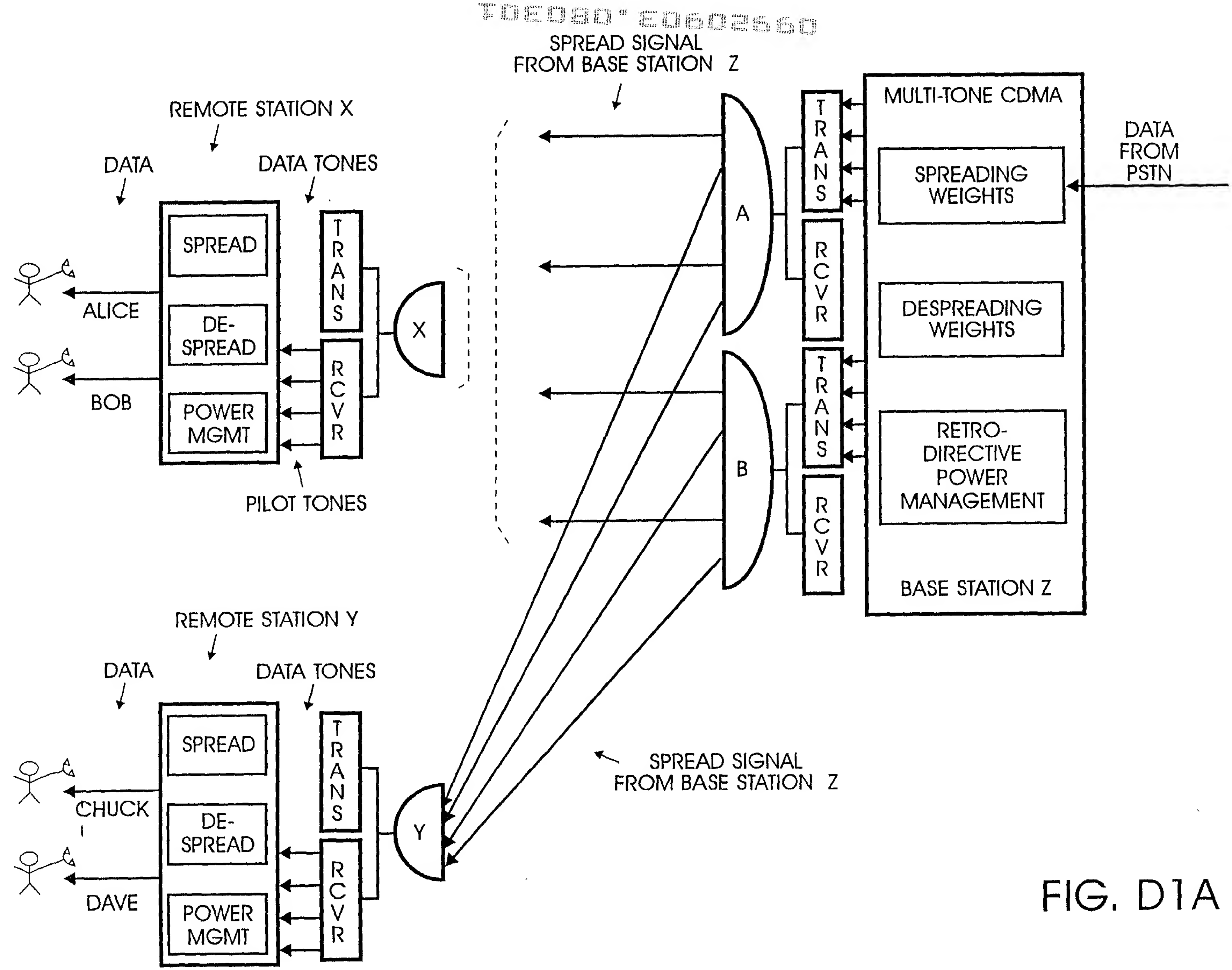
FIG. C3



BASE STATION Z
DATA TONES
A
B
C
D
RECEIVER 310
SPECTRAL AND SPATIAL DESPREADING PROCESSOR 312
TRELLIS DECODER 314
DATA VECTORS
VECTOR DISASSEMBLY BUFFER 316
ALICE'S DATA
BOB'S DATA
FUNCTIONAL QUALITY & MAINTENANCE ARCHIVE BUFFER 320
REMOTE STA. X SELF-TEST RESULTS BATTERY STATUS SINR HISTORY PATH LOSS HIST.
REMOTE STA. Y SELF-TEST RESULTS BATTERY STATUS SINR HISTORY PATH LOSS HIST.
COMMON ACCESS CHANNEL VECTOR
FUNCTIONAL QUALITY PROCESSOR 322
MAINTENANCE PROCESSOR 330
MAINTENANCE NOTICE DATA 350
UPDATE WEIGHTS
SPREADING & DESPREADING WEIGHTS BUFFER 340
FUNCTIONAL QUALITY & MAINTENANCE DATA ON COMMON ACCESS CHANNEL TONE

FIG. C4


700
710
REMOTE STATION: MONITOR AND BUFFER FUNCTIONAL QUALITY DATA, INCLUDING SINR & PATH LOSS, FOR SESSIONS WITH BASE STATION
720
REMOTE STATION: MONITOR AND BUFFER MAINTENENCE DATA, INCLUDING SELF-TEST RESULTS, FOR REMOTE STATION
730
BASE STATION: TRANSMIT POLLING SIGNAL ON COMMON LINK CHANNEL TONE TO REMOTE STATION
740
REMOTE STATION: ACCESS FUNCTIONAL QUALITY DATA & MAINTENENCE DATA, ASSEMBLE MESSAGE, AND TRANSMIT ON COMMON ACCESS CHANNEL TONE TO BASE
750
BASE STATION: PERFORM SPECTRAL AND SPATIAL DESPREADING OF COMMON ACCESS CHANNEL TONE AND DATA TRAFFIC TONES
760
BASE STATION: PERFORM TRELLIS DECODING OF DESPREAD COMMON ACCESS CHANNEL TONE AND DATA TONES
770
BASE STATION: ARCHIVE FUNCTIONAL QUALITY AND MAINTENANCE DATA IN BASE STATION
780
BASE STATION: ANALYZE FUNCTIONAL QUALITY DATA AND UPDATE DESPREADING AND SPREADING WEIGHTS TO MAXIMIZE QUALITY OF REMOTE STATION CHANNELS
790
BASE STATION: ANALYZE MAINTENANCE DATA AND OUTPUT MAINTENANCE NOTICE TO REPAIR OR REPLACE FAILING COMPONENTS AT REMOTE STATION



SPREAD SIGNAL FROM BASE STATION Z
REMOTE STATION X
DATA
DATA TONES
SPREAD
DE-SPREAD
POWER MGMT
TRANS
RCVR
X
ALICE
BOB
PILOT TONES
MULTI-TONE CDMA
SPREADING WEIGHTS
DESPREADING WEIGHTS
RETRO-DIRECTIVE POWER MANAGEMENT
BASE STATION Z
DATA FROM PSTN
A
B
REMOTE STATION Y
DATA
DATA TONES
SPREAD
DE-SPREAD
POWER MGMT
TRANS
RCVR
Y
CHUCK
DAVE
SPREAD SIGNAL FROM BASE STATION Z

FIG. D1A

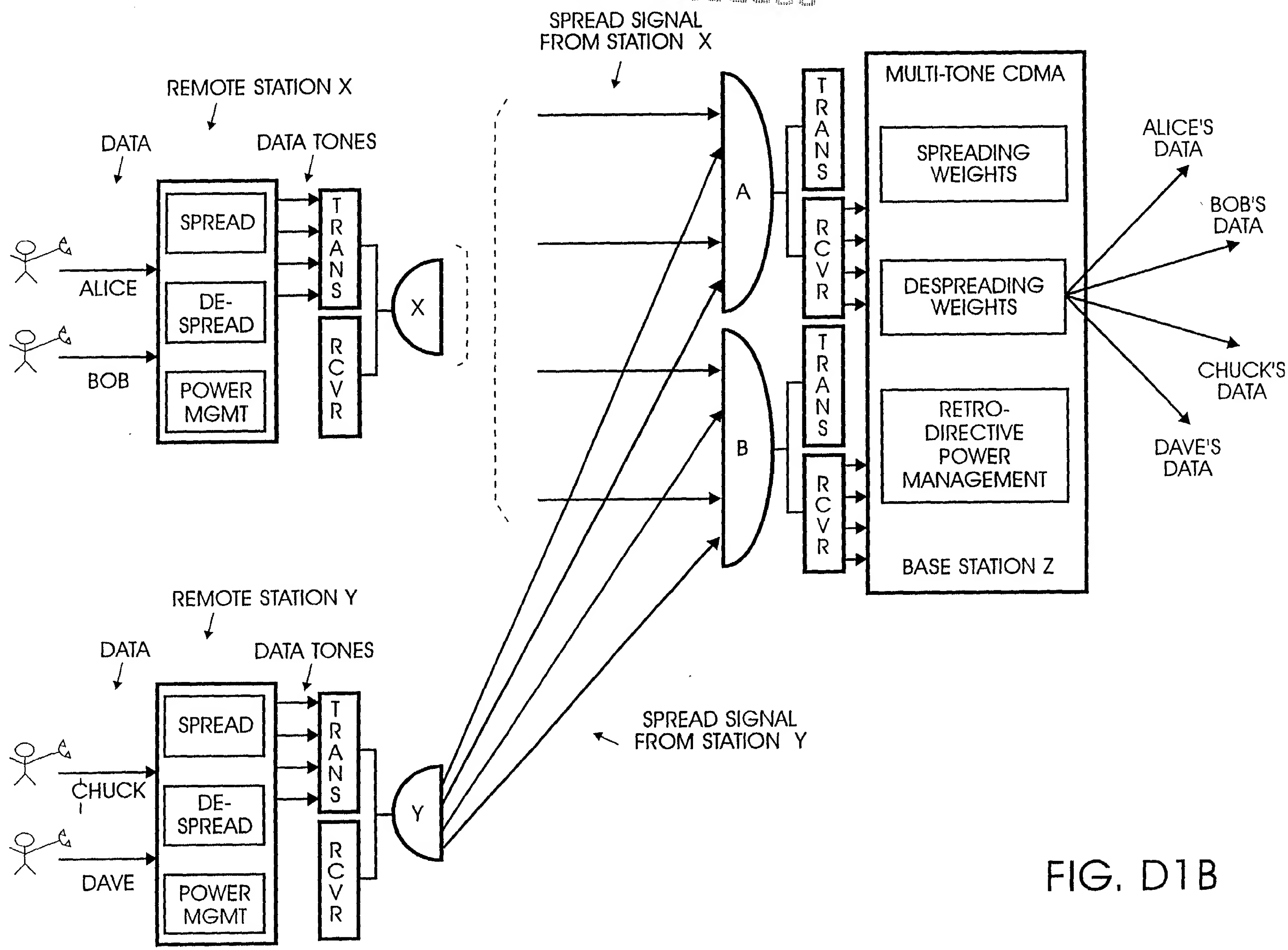

SPREAD SIGNAL
FROM STATION X
REMOTE STATION X
DATA
DATA TONES
SPREAD
DE-
SPREAD
POWER
MGMT
ALICE
BOB
TRANS
RCVR
X
A
B
TRANS
RCVR
TRANS
RCVR
MULTI-TONE CDMA
SPREADING
WEIGHTS
DESPREADING
WEIGHTS
RETRO-
DIRECTIVE
POWER
MANAGEMENT
BASE STATION Z
ALICE'S
DATA
BOB'S
DATA
CHUCK'S
DATA
DAVE'S
DATA
REMOTE STATION Y
DATA
DATA TONES
SPREAD
DE-
SPREAD
POWER
MGMT
CHUCK
DAVE
TRANS
RCVR
Y
SPREAD SIGNAL
FROM STATION Y

FIG. D1B

FIG. E1A

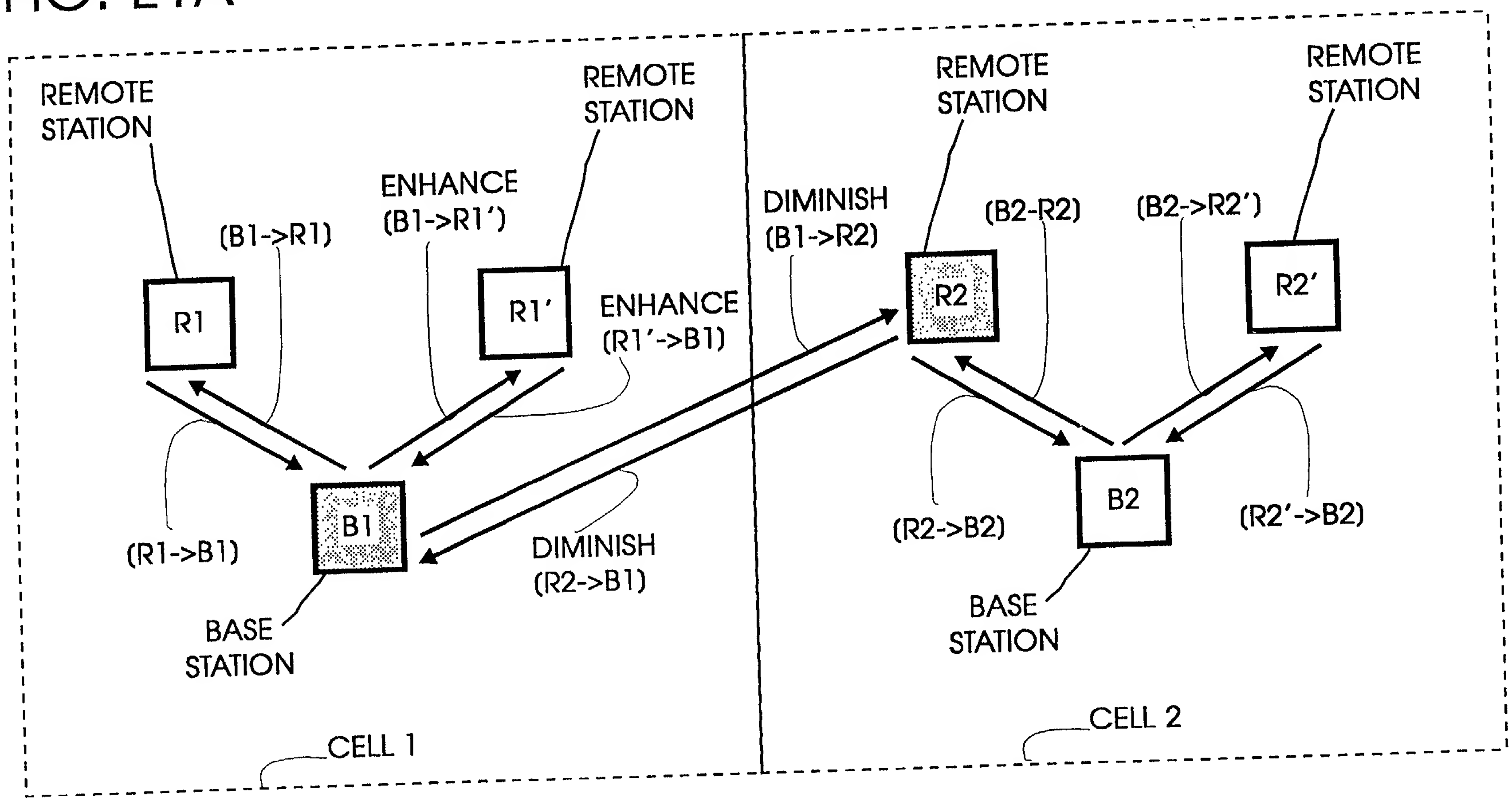
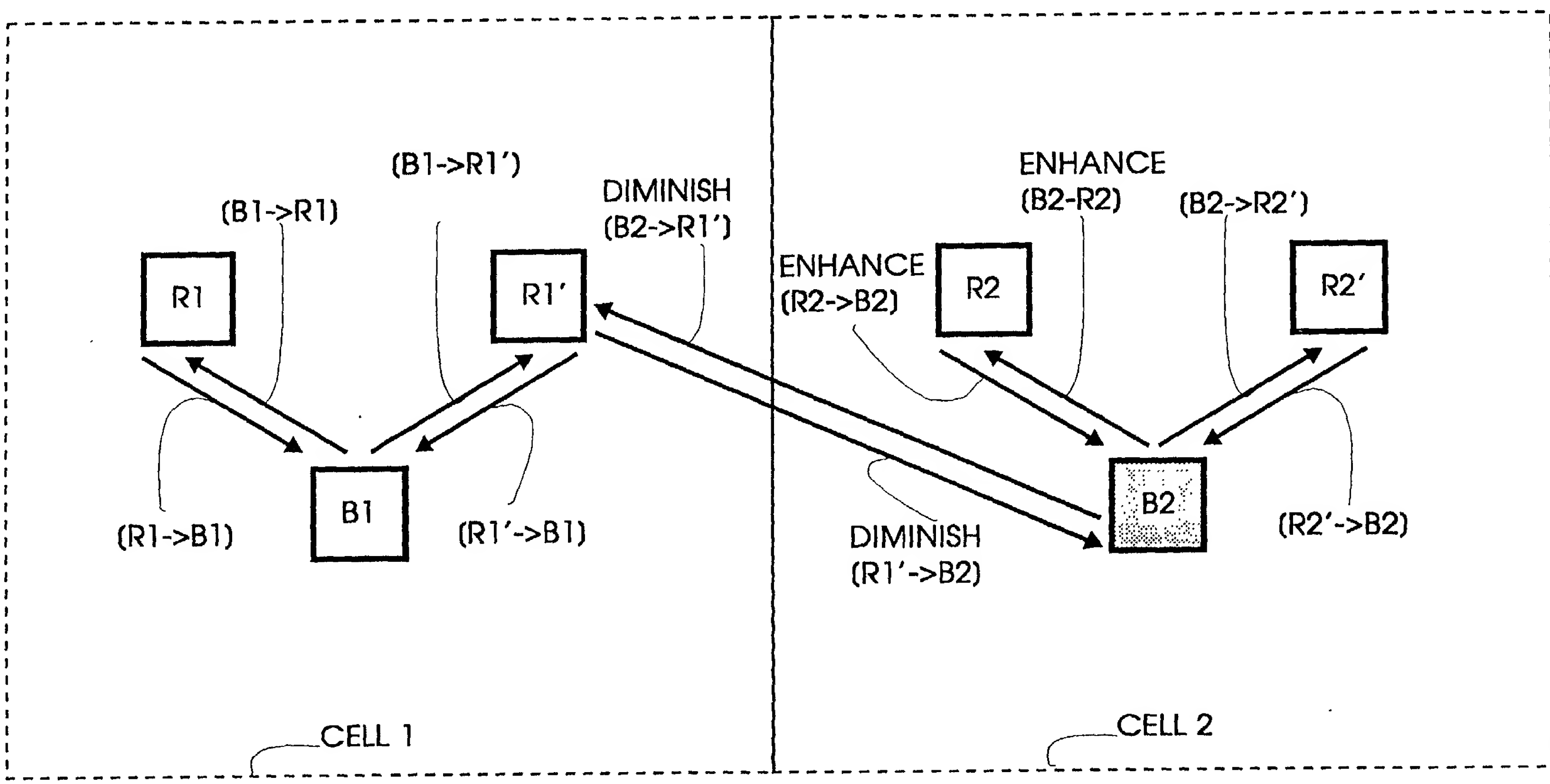

REMOTE STATION
R1
(B1->R1)
(R1->B1)
B1
BASE STATION
ENHANCE (B1->R1')
R1'
REMOTE STATION
ENHANCE (R1'->B1)
DIMINISH (R2->B1)
CELL 1
DIMINISH (B1->R2)
REMOTE STATION
R2
(B2-R2)
(R2->B2)
B2
BASE STATION
(B2->R2')
R2'
REMOTE STATION
(R2'->B2)
CELL 2

FIG. E1B



(B1->R1')
(B1->R1)
DIMINISH
(B2->R1')
ENHANCE
(B2-R2)
(B2->R2')
ENHANCE
(R2->B2)
R1
R1'
R2
R2'
B1
B2
(R1->B1)
(R1'->B1)
DIMINISH
(R1'->B2)
(R2'->B2)
CELL 1
CELL 2

FIG. E1C

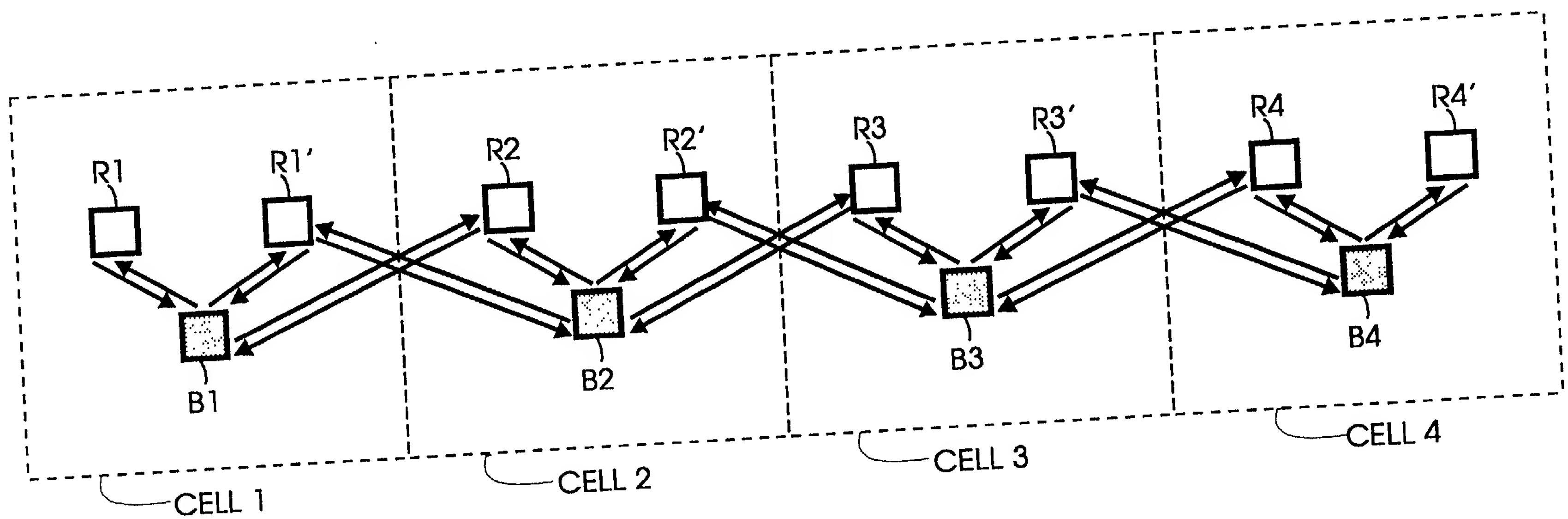
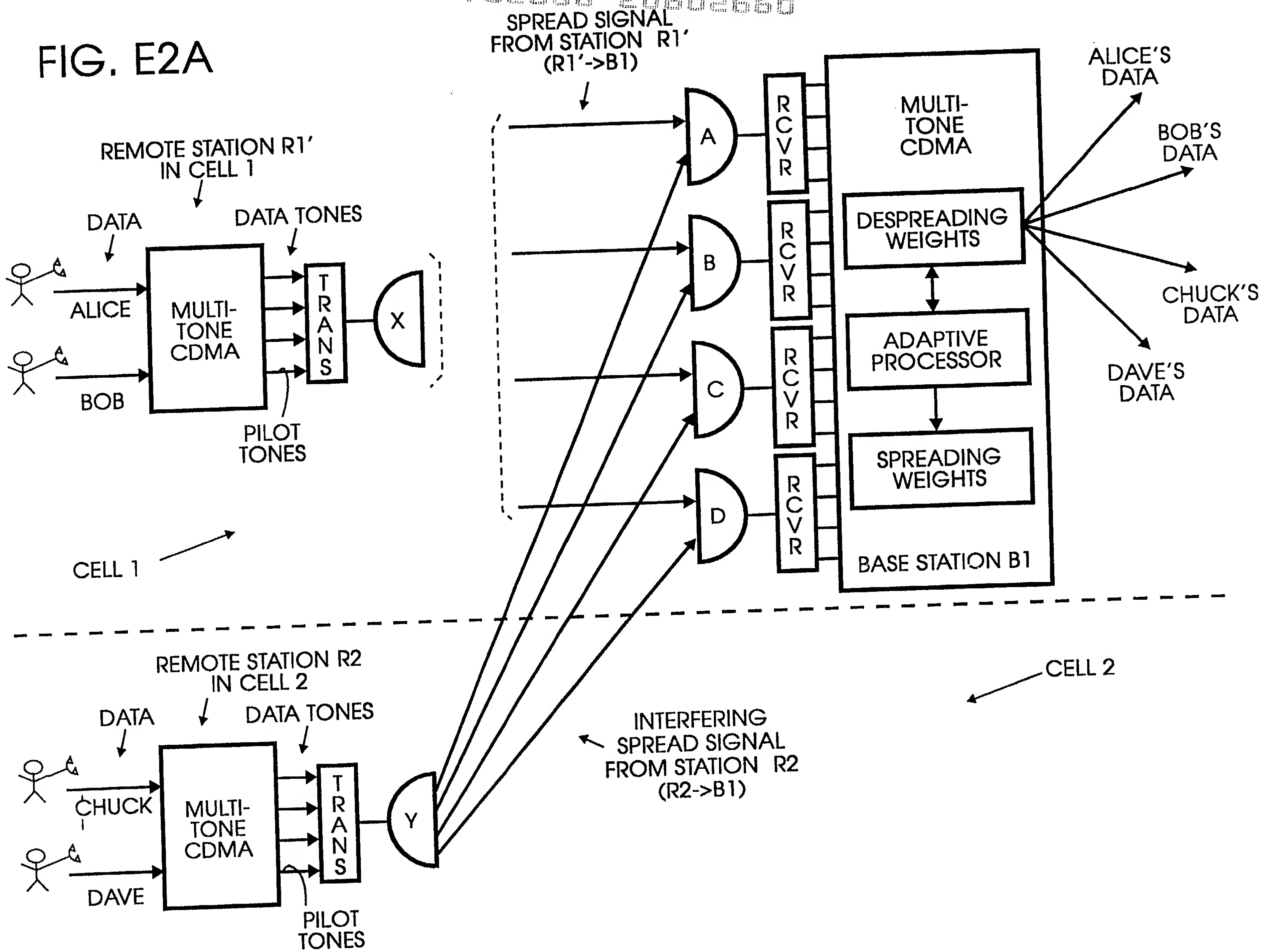
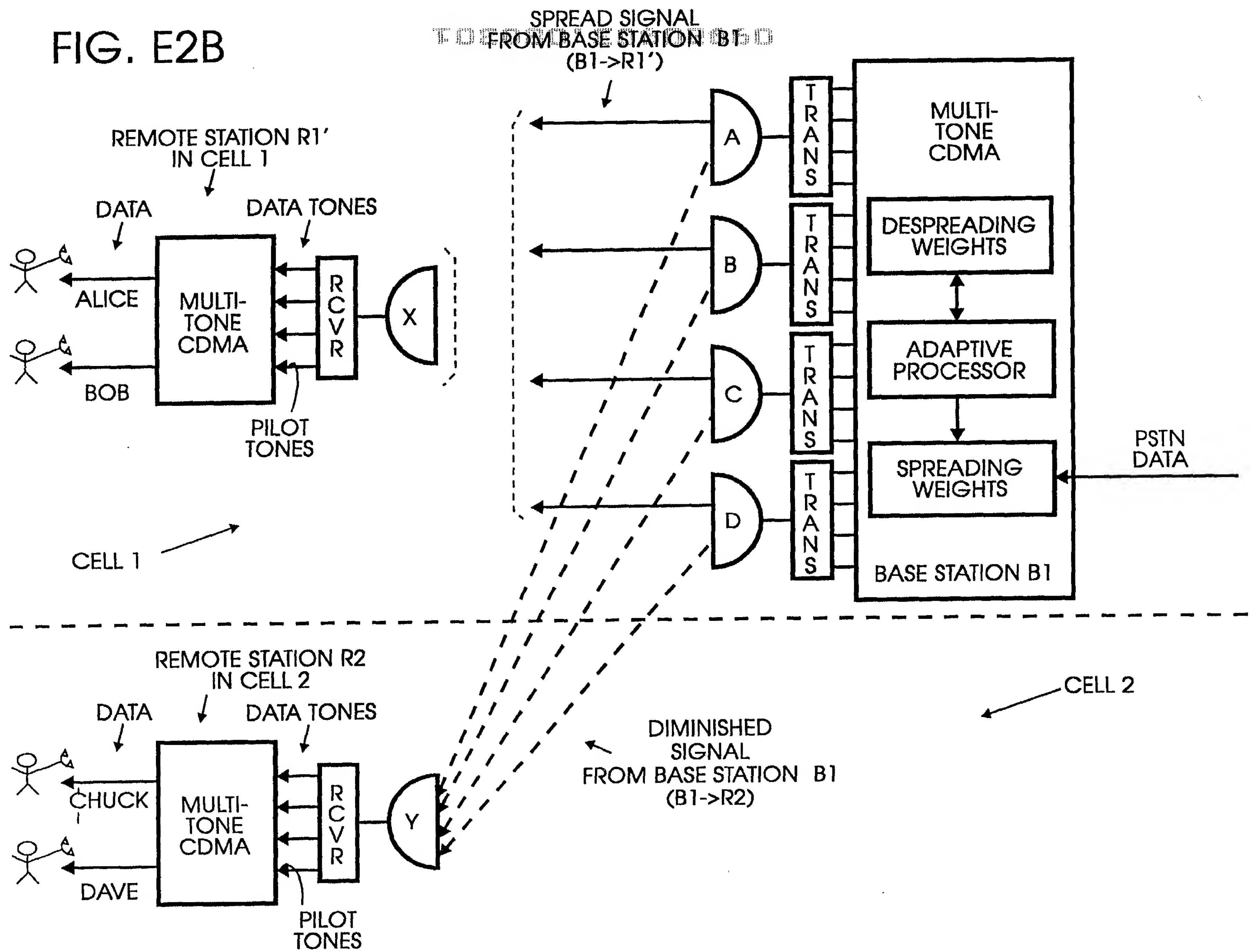


FIG. E2A



SPREAD SIGNAL FROM STATION R1' (R1'->B1)
REMOTE STATION R1' IN CELL 1
DATA
DATA TONES
ALICE
BOB
MULTI-TONE CDMA
TRANS
X
PILOT TONES
CELL 1
A
B
C
D
RCVR
MULTI-TONE CDMA
DESPREADING WEIGHTS
ADAPTIVE PROCESSOR
SPREADING WEIGHTS
BASE STATION B1
ALICE'S DATA
BOB'S DATA
CHUCK'S DATA
DAVE'S DATA
REMOTE STATION R2 IN CELL 2
DATA
DATA TONES
CHUCK
DAVE
MULTI-TONE CDMA
TRANS
Y
PILOT TONES
INTERFERING SPREAD SIGNAL FROM STATION R2 (R2->B1)
CELL 2

FIG. E2B



SPREAD SIGNAL
FROM BASE STATION B1
(B1->R1')
REMOTE STATION R1'
IN CELL 1
DATA
DATA TONES
ALICE
BOB
MULTI-
TONE
CDMA
RCVR
X
PILOT
TONES
CELL 1
A
B
C
D
TRANS
TRANS
TRANS
TRANS
MULTI-
TONE
CDMA
DESPREADING
WEIGHTS
ADAPTIVE
PROCESSOR
SPREADING
WEIGHTS
BASE STATION B1
PSTN
DATA
REMOTE STATION R2
IN CELL 2
DATA
DATA TONES
CHUCK
DAVE
MULTI-
TONE
CDMA
RCVR
Y
PILOT
TONES
DIMINISHED
SIGNAL
FROM BASE STATION B1
(B1->R2)
CELL 2